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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Progress of "Perlit" Iron.

It is just two years since we first expressed our views on what we then termed Diefenthaler's Pearlitic cast iron, and suggested the time had arrived for dividing cast irons into three types, hyper-pearlitic, pearlitic and hypo-pearlitic cast iron. Since that time we have changed our views but little, and as time is showing that an enormous quantity of work is being done on what is now Lanz Perlit iron, and its properties are being determined. Thus there is accumulating large quantities of data, which in the normal course of events will be compared with hypo and hyper cast-irons. We have had the opportunity of seeing the material made and tested in Germany, and the tests confirmed in every way the results published by Dr. Bauer. The iron "Z" or cylinder iron referred to by Bauer proved to be one which passes the official tests imposed by the German State Railways and other official bodies.

We have recently had an opportunity of discussing the progress being made on the Continent with Mr. Meyer of the Lanz Company. It seems that the licensees have banded themselves for certain commercial purposes, and for what to our mind is still more important the prosecution of research work on this particular phase of high duty cast iron. A meeting was recently held in Düsseldorf in which the French (Société Alsacienne de Construction Mecanique) and Italian (Breda) participated. Each licensee was asked to make four castings of standard dimensions, and report to their Council the results obtained. The test castings consisted of a hollow cube; a heavily flanged very thin-walled cylinder; a thick and thin barred grid of heavy end sections, and Cook's K test. Up to now we are informed that the tests have been more than satisfactory, and in order that normal hydraulic testing machines could be used for testing to destruction, the thick-flanged pipe casting has been in the body reduced to 3 mm. We are further informed, which was what we anticipated, that much research is in progress to determine the influence of elements on "Perlit" cast iron. This product, it will be remembered, can have a varying composition, but with the variations there is instituted a control of the thermal history so as invariably to give an all-pearlite-graphite structure. The formation of this structure appears to effect the graphite so as to produce the curly variety. This effect is being carefully investigated, *inter alia*, utilising iron cast at very high temperatures with the object of producing the nodular type of graphite such as one associates with black-heart malleable.

Mr. Meyer further informed us that since the introduction of the new system of intensive control, there have been many new laboratories installed in German foundries, and there has been a consistent improvement in the general technique of castings manufacture throughout the republic.

How will this affect the foundries of Great been granted, and preliminary work is in progress. Many others have had their thoughts directed in the direction of composition and thermal history control, which is all to the good. The B.C.I.R.A., too, are cognisant of the latest developments, and are vigorously prosecuting their researches into allied matters. Germany is finding it increasingly difficult to find young men suitably trained for this class of work. Here, owing to the prolonged depression in the steel trades, there is a large reserve of well-trained metallurgical chemists who are well qualified to supervise such work.

The Glasgow Convention Entertainment Fund.

As a result of the appeal which is being made by the Scottish Branch of the Institute of British Foundrymen for funds to enable them to entertain visitors to the Glasgow Conference, a sum of practically £300 has been received. It is hoped to raise at least a further £200, and donations should be sent to Mr. John Bell, the Honorary Secretary, at 60, St. Enoch Square, Glasgow.

The following is a list of subscriptions received to date:—

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Steel Production in South Africa.

In his recent Presidential address to the South African Institute of Electrical Engineers, MR. H. W. CLAYDEN said that the manufacture of steel in South Africa was increasing. There were now four electric-arc furnaces of from 2 to 7 tons capacity supplied from the Witwatersrand power system. These were melting steel for various purposes, and the majority of the mine requirements in steel castings, except special steels, were being produced locally, chiefly from the electrically-melted and refined metals. At present most of the steel produced was from scrap steel and iron melted either in open-hearth or electric furnaces. The quantity melted per month was in the neighbourhood of 2,500 tons, and the discard as scrap per month by the mines, railways, and industries of the country was not more than half that amount. For the last ten years steel in South Africa had been produced from the accumulated scrap of 30 years in mining and industries, but the time was rapidly approaching when unless dependence could be placed upon ore mined and iron produced in the country the steel industry on which much capital had been expended would cease to exist.

During the war an electric smelting plant was installed by the Witwatersrand Co-operative Smelting Works for the manufacture of the battery shoes and dies required by the mills of the Rand. This plant had grown in size, and was to-day, with three induction and one arc furnace installed, producing over 400 tons of shoes and dies per month. This product was disposed of to the mines at approximately 20 per cent. less cost, based on running life, than the imported article. It was proposed at an early date to install a hydraulic press, when the shoes and dies manufactured would be equal in quality to the imported articles, but would be produced at from 25 to 30 per cent. below the imported cost. This industry had grown, and was now providing employment for 18 Europeans. It, however, depended entirely on the supply of scrap steel for output and future development.

The project of producing all steel and iron requirements for South Africa from ore mined in the country was almost an accomplished fact, and would undoubtedly add to the power requirements for the local manufacture of much of the machinery and farm implements which at present were imported. In every country in the world the establishment of an iron and steel industry had been the forerunner of industrial prosperity.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Eye-Protection in Industry.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We have read with interest your leader on this subject in your issue of April 30. Certainly the industrial worker of this country has developed a "safety-first" sense. Generally speaking, he appreciates the need of eye-protection, but he (and in most cases his employer) has never yet understood, has never been taught, the full nature of the danger and the meaning of efficient protection.

He has been satisfied to have—his employer may have been satisfied to furnish him with anything that had two eyecups and a pair of glasses—made up without any special consideration of the needs of the wearer and of the conditions it is required to meet. Often it was a pair of blue glasses that reduced the workers' efficiency because it absorbed an undue proportion of the useful rays of light and failed to arrest the heat and actinic rays which were the unseen danger of his job. Badly-made and uncomfortable, reducing his efficiency without any corresponding advantage, such goggles were often laid aside as a nuisance to be worn as infrequently as possible.

Many a workman neglects to protect his eyes from flying fragments because he has no confidence in two pieces of ordinary sheet glass placed before his eyes. The possible shattering of these is to him as bad a prospect as the chance of receiving the flying fragment itself. Let him know that his goggles are fitted with a glass specially prepared to resist violent impact, and he will take them up again with confidence.

The average employer here has yet to realise that efficient protection of the eyes can only be given by glasses scientifically prepared to meet the particular conditions of each industry without unduly impairing the efficiency of the worker. With realisation of this fact and the provision of the best available protection will come increased efficiency and output of the worker.—Yours, etc.,

R. GRANGE.

146, Clerkenwell Road, London, E.C.1.
May 20, 1925.

Importance of Venting with Special Reference to Defective Castings.

By E. Longden.

In this Paper a little information will be given with a view to focussing attention on the effect of gases, especially those given off from the mould during pouring, on the soundness of grey iron castings. Personally the author is convinced that mould gases are responsible for a far greater percentage of the defective casting trouble than has been generally recognised.

The conclusions are based on a number of simple experiments and a very fortunate and exceptional experience with small and large castings of simple and intricate designs. From the evidence so collected the author has been forced to associate the defects which are usually described as liquid shrinkage cavity and porosity to gases generated in the mould and those occluded by the metal during cooling. Interaction between mould and occluded gases is very probable, and if it were possible to eliminate mould gases the amount of liquid shrinkage in grey iron would be negligible, and the problems which beset the metal founder would be very considerably reduced.

FIG. 1.—VARIOUS SECTIONS SHOWING POROSITY.

Soundness increases progressively with a reduction in mould gases. From such deductions it would follow that, if we cannot altogether eliminate these gases, provision must be made for their speedy evacuation through the pores of the sand and vents.

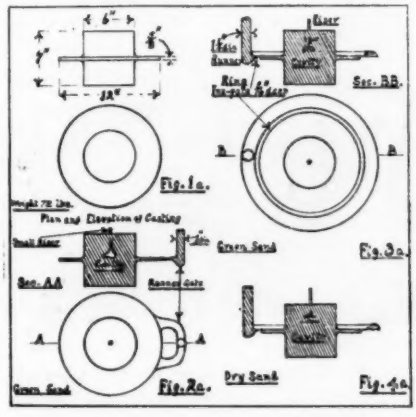
When molten metal enters a sand mould large volumes of gases are formed, generated from combustible materials and chemical decomposition of substances composing the mould, to which can be added gas occluded by the cooling metal. To minimise the effect of such gases on the soundness of castings forms a very important part of the moulder's work. Great care and ingenuity is exercised in conducting gas away from cores and moulds.

Defects Attributable to Gases.

Defects which could be attributed to gases are very numerous, and could be said to be caused by: Insufficiently dried cores and moulds when dry-sand and loam moulding is attempted; excessively hard-rammed cores and moulds; in some instances lack of ramming locally, because a pocket of loosely-rammed sand provides an easy exit for the gases generated in the harder surrounding sand, so that the gas easily flows forward into the mould cavity and metal; abuse of the swab locally or too much moisture in the sand generally, especially when green sand moulding; lack of the natural venting properties of moulding sand; omitting artificial venting; improper use of the vent wire, because if deeply probed it will be found that quite an appreciable percentage of blow holes are due to the over sharp vent wire which is so often thrust through the sand and penetrates the pattern; the fine holes so formed are easily passed over by the moulder, and when the metal enters the mould the generating gases blow through into the mould cavity and later the metal; incorrect sand mixtures for the particular type of casting; faulty sand mixing; faulty and wrong mixtures of mould dressing; allowing metal to penetrate subsidiary and main vents in core or mould; choking of vents by sand due to unskilful manipulation; blow holes from inserted solid metal which has not received correct treatment such as, denseners, chills, nails, studs or chaplets, also these pieces of metal in spite of much care attract and condense steam created in a green sand mould in which has been placed a warm core, or from an imperfectly dried mould, closed warm and then allowed to stand so that it cools before receiving the metal; blow holes from wet loam stamps which are placed on cores to make up the common errors in size between core and mould print; absence of openings or risers for exhausting mould gases quickly, particularly in confined sections of the mould and especially if the nature of casting compels rapid pouring; insufficient fluid head pressure; escape of metal from mould with the consequent arrest or ebb and flow of the molten iron; incorrect gating so that metal enters mould wildly, or too slowly, perhaps the metal enters and impinges on the mould or cores eddying and churning so that air and other gases are mechanically mixed with the metal, or it may be that the gate is so concentrated on one portion that sand becomes overheated and the gases escape from the mould face into the metal rather than through the back sand which has become unduly overburdened with gas generated at very high pressure; it may be that metal has such a tortuous passage due perhaps to wrong location or insufficient git that it becomes lifeless and unable to expel collected gases, for it might be said that the very act of pouring tends to create blow holes because of agitation; omitting to feed metal through riser gates to replace escaping gases and badly located feeders; dull iron because there is always much more difficulty in obtaining castings free from blow holes when the moulds are poured with sluggish iron for whatever might be the cause the gas cannot find its way out if the metal is viscous—good hot iron hides much faulty venting, etc.; wrong mixture of metal for the particular type of casting and last but not least the difficult, and very often absurd, design of casting which makes it practically impossible to conduct gases rapidly enough away from the mould or core.

Mould Gas and Moulding Sands.

The moulding material from which gases are generated is worth a little attention. What are



termed "natural moulding sands" consist of, before preparation, substances in something like the following proportions:—Silica 73 to 92, clayey matter 6 to 14, oxide of iron 2 to 5, lime 4 to 2.5, magnesia up to 1, and water up to 10 per cent.

Sands are specially prepared for facing the metal. When mixing facing sands other materials are added depending on the class of mould or core such as:—Coal dust, manure, sawdust, hair and artificial binders like core gum, molasses, flour, sugar, resin, vegetable and mineral oils, etc. Then there are the various refractory materials which are applied to protect the face of the mould and give

a good looking finish to the casting which are:—Plumbago, charcoal, and mineral blackings, ground silica, core gum, etc.

Each of these materials have special virtues when rightly used, and give a combination of properties required in moulding materials, the desirables being:—Refractoriness, porosity, plasticity, adhesiveness, cohesiveness, power of taking up water to about 6 per cent. by weight, and resistance to distortion at high temperatures.

The most successful sands and refractories are those which give above properties with the maximum connected pore spaces around the sand grains for gas exit when metal enters the mould. A large

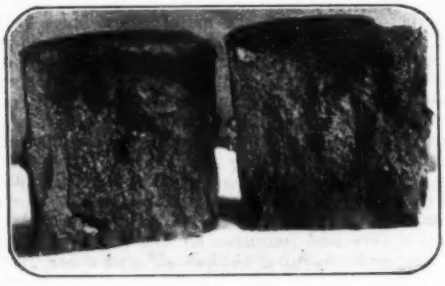


Fig. 2.—The Left-hand Fracture is from a Green-Sand Mould, and the Right Dry Sand.

average porosity could be obtained by a number of large unconnected pore spaces.

Sands and refractories may lose as much as 15 per cent. of weight when subjected to molten metal temperatures and the facing sand for a considerable depth from the surface is very much changed in physical properties chiefly due to ignition and burning of coal dust and organic matter and dehydration of the iron oxide and clay bond. Water (mechanically mixed) is dried out at a low heat and the water of combination lost at a temperature of dull red heat.

These chemical changes are accompanied with the formation of large volumes of gas although infinitesimal in weight. An idea of the space these gases occupy can be gauged by considering several substances. At a temperature of about 880 deg. C., the aqueous bond (water) is broken up into its constituents hydrogen and oxygen, and if allowed to expand freely would occupy about 9,000 times its original volume. Much of the water is, of course, only converted into steam, even so the steam occupies about 1.440 times the space as the water from which it is formed. Coal dust when heated may give a gas volume, chiefly hydrocarbons, of something like 400 times its bulk, and expand con

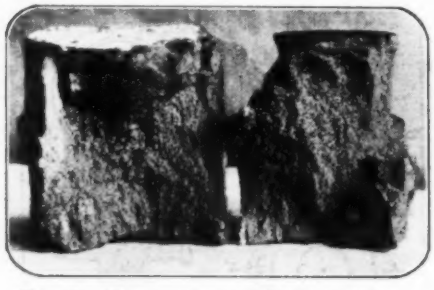


Fig. 3.—Fractures from Moulds Cast in Ganister (Left) and Plumbago (Right).

siderably more at high temperatures. Gases expand very much more than liquids or solids within very wide ranges of temperatures and with very uniform expansions; also changes of pressure which have practically no effect on the volume of liquids and solids have an enormous effect on the volumes of gases. If the gas be confined, and is prevented from expanding a tremendous pressure is possible, and when ignition takes place violent explosions may occur especially if gas is contained in a closed vessel.

Hydrocarbons are decomposed by the hot metal and graphite deposited on the face of the sand. It is considered that this change is not quite the same if the sand is too damp and graphite is not deposited. This would account in some instances for the burning-on of sand as in the case of loam and dry-sand moulds which have been insufficiently dried. Steam is discharged from the surface of the mould and is decomposed by the hot metal, and probably the oxygen combines with the graphite at its ignition temperature, thereby robbing the mould surface of its refractory cover, resulting in the

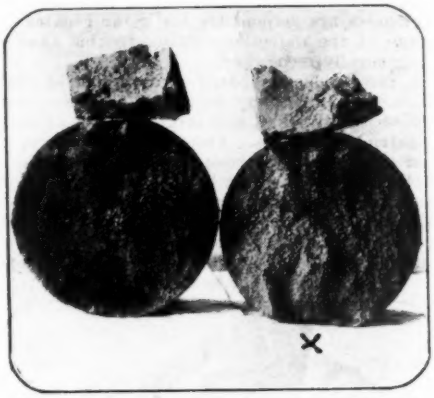


Fig. 4.—Fractures of Spheres, the Left being Poured in Green Sand and the Right in Dry Sand. The Top of the Latter is Marked with a X.

grey burnt-on sand appearance. With green sand in the ordinary way carbon from the coal dust would appear to combine with the oxygen which is liberated when water is split up into its elements and also with the oxygen in the pore spaces of the sand, the pore spaces in good moulding sand being about 25 per cent. of the bulk and in cores about 40 per cent. Additionally, the combustible substances may burn in the air contained in the pore spaces, and under certain conditions prevent burning-on of sand. The coal gas forms a film on which the metal flows, thereby protecting the sand.

When considering the volumes of gases generated in dry- and green-sand moulds the author is inclined, when examining superficially, to state that greater volumes of gas would be formed in the green-sand mould than the dry-sand mould, but this must be modified, because the cooling effect of the damp backing sand in a green-sand mould will tend to reduce the volume somewhat. The heat from the metal which volatilises the coal dust and converts the water to steam absorbs heat for the

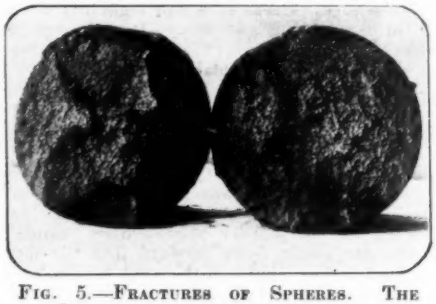


Fig. 5.—Fractures of Spheres. The Left has been Cast in Plumbago and the Right in Ganister.

time being, thereby cooling the sand and preventing burning-on of sand.

Gases occluded by metals are stated to be:—Hydrogen, nitrogen, carbon monoxide and carbon dioxide. Gases can be noticed escaping during feeding operations, but are mainly mould gases.

Instances are on record where gas emanating from pig-iron after drilling amounted to 75 per cent. in volume of the metal removed and when a flat drill was used, thus crushing the metal thoroughly in removing it, the volume rose to 600 per cent. of the metal removed.

Combustion is defined as vigorous chemical combination attended with light, and that chemical combination is often attended with evolution of heat.

In thermal chemistry it is laid down that: Every chemical change without the intervention of extraneous force tends to produce those bodies the formation of which will evolve most heat. This is called law of greatest energy, and is considered of great importance. From it it follows that reactions which are exothermic tend to take place more

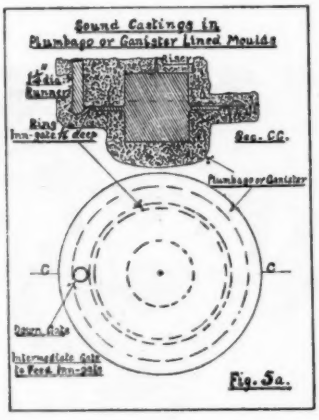


Fig. 5a.

readily than those which are endothermic, and also that bodies which are formed with the absorption of heat are usually less stable than those in the formation of which heat is evolved and that heat of reaction depends on temperature.

It is considered impossible for two different gases to remain in separate layers however much their densities differ, and that diffusion takes place rapidly. One only needs to think of the impossibility of life with industry if this were not so. The air in industrial districts would soon be displaced by the heavier gases. Agitation assists diffusion.

The agitation which occurs at the overheated sections of a mould or core due to gas blowing into the metal assists in diffusion of gas into the metal. Gases have the power both of diffusing through and of being retained by solid substances. Hydrogen can be readily diffused through cold cast iron.

Bearing these points in mind, one would be bold to state that it is not possible for reactions to take place between carbon in the metal and oxygen from the mould which might be blowing into the metal at great pressure. Other heat-forming reactions are possible with other gases. A kind of local Bessemerising is possible. If such changes take place it would account for the sponginess and cavity in certain sections of grey iron.

One need not be surprised at the feasibility of such reactions mentioned when considering the practicability of partly desulphurising a ladle of molten cast iron by merely placing soda ash or sodium carbonate on the surface of the metal. It does appear that the supposed liquid shrinkage in grey iron could almost be ignored if mould gases could be eliminated. Graphitisation of carbon in iron is mainly responsible for the low shrinkage compared with other metals. Elements in grey iron such as silicon tend to reduce the effect of gases.

It is not impossible that graphite is present in grey iron a little before solidification. The author is aware that he is ploughing a lone furrow when he makes such a statement, and that he will be reminded of the "common salt in water" diagrams; but cast iron is not a simple solution like salt in water, and conditions may obtain in a complex mixture like grey iron which are not explained by the iron-carbon equilibrium diagrams. Grey iron consists of, in addition to iron, an average of 7½ per cent. by weight of impurities made up of carbon, silicon, manganese, phosphorus, sulphur, traces of other impurities and gases. These elements can be twisted and altered in so many ways that grey iron is still insufficiently understood. Others, again, will remind me of the very meagre experiments carried out whereby a thin streak of molten grey iron has been suddenly cooled from a very high temperature by allowing to pour in iced water, and that all carbon was obtained in combination with the iron. Possibly this is not sufficient proof, because by suddenly chilling an enormous pressure is applied by the envelope of the metal contracting instantaneously and preventing deposition or growth of graphite. It is a well-established rule that pressure in and by itself favours the formation of the less bulky of the possible conditions, or state, or phases.

It is most likely that carbon is in solution with iron at the high temperature of melting, but it is also possible that a certain amount of graphite is formed or precipitated during the temperature interval between the highest and the point of freezing at something like 1,130 deg. C. If grey iron melts at 1,500 deg. C. there is something like a fall of 370 deg. C. of heat before setting; this means that grey iron freezes at a lower temperature than its melting point, because the carbon must first be dissolved before the metal will melt. So that the dissociation of carbide is accompanied by an evolution of heat. *i.e.*, is exothermic. This dissociation can be recorded after solidification, showing several volumes changes, but dissociation before solidification is much more difficult to record, and critical solution temperatures at which a special form of graphite is deposited is possible before solidification as well as after solidification.

Kish is described as excess carbon, and is due to certain forms of carbide. Here is an instance where proof is given that under certain conditions graphite is formed before solidification. The growth and precipitation of graphite on the cooling metal envelope exerts a pressure internally, thereby compensating for liquid shrinkage.

In a Paper read before the Faraday Society on November 12, 1918, on the "Occlusion of Gases by Metal," Sir Charles Parsons, F.R.S., said:—

"If a small crucible containing ordinary cast iron is intensely heated in the electric furnace and then quickly placed while molten under hydrogen at 2 tons pressure per sq. in. a very large amount of graphite is ejected in a dense layer below the metal, which wells up and overflows the crucible. Finally, the iron is white and hard, containing much combined carbon. If, on the other hand, carbonic oxide is similarly admitted instead of

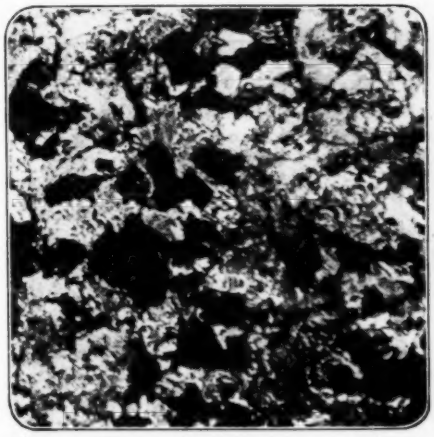


Fig. 6.—Cast in Green Sand. × 250 dias.

hydrogen, no layer of graphite is formed, and the metal remains grey cast iron."

"Dr. Hatfield undertook the analysis of the samples of the metal so treated, and he tells me that both contained about 4 to 5 c.c. of occluded gases per grain of iron; in the one case almost wholly hydrogen, and in the other almost wholly CO.

"I have noticed the remarkable difficulty with which gases pass out of molten cast iron under a high vacuum."

Prof. Armstrong then stated: "The idea is growing in Sir Charles Parsons' mind that hydrogen has something to do with the production of graphite. I venture to say that graphite is not a form of carbon, and that there is but one form of carbon, viz., diamond; graphite and the various

charcoals are, in my opinion, probably compounds of carbon with a very small proportion of hydrogen."

Now as cast iron contains much hydrogen it is possible that graphite may be precipitated a little before solidification due to the presence of hydrogen.

During the last forty years our scientists have discovered and revealed many wonderful things. Many are familiar with the gas discoveries made during the latter part of the war, but they are not so sensational as the discoveries made by such men as Sir William Ramsey, Professor Soddy and collaborators, commencing the year 1894, which gave the very remarkable information that the air contains, in minute amounts true, in addition to oxygen and nitrogen, six gases, which were named Helium, Neon, Argon, Krypton, Xenon, Niton.

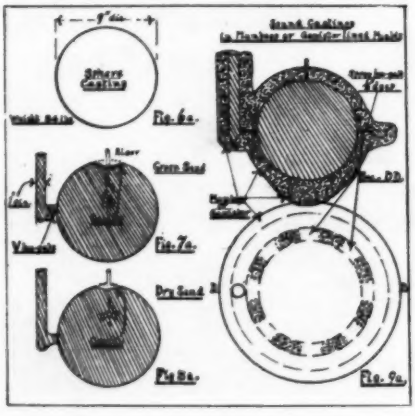
Venting Green Sand, Dry Sand and Loam.

The practice of venting varies somewhat in different parts of the country, the variation being due, in the main, to the quality and availability of sands, as also does the determination of whether to mould in dry sand or green sand. Although such a statement must be modified considerably because the ability of moulders in certain districts and shops to produce castings in green sand which would in the majority of places be made in dry sand is very evident. Again, certain firms demand higher quality castings than others. So that with special castings which must stand a high finish the bias must be in favour of a dry-sand mould.

A correctly made dry-sand mould will produce a high quality casting, both in looks and soundness, than a green-sand mould, and with less risk of waste; also a correctly made loam mould will give better results than either. It does not always follow that the loam or dry sand will be more costly to produce. There are many instances whereby a loam mould or dry-sand mould can be made much more quickly than one in green sand.

The nature of moulding determines that a dry-sand or loam mould, especially the latter, will be freer venting and with less gases present than green sand. That is the reason that one can expect with a dried mould greater freedom from those embarrassing defects which are disclosed after machining important castings.

The removal of moisture in dry sand and loam creates porosity, as does also the expansion of



grains of sand when heated, because they do not quite return to their original position.

Loam when dried is very porous, less artificial venting being needed. Except when building loam around a pattern, only a thin layer is struck up on brickwork. The loam is not compressed by ramming, as is the case with ordinary sands, and for that reason is more open. Cinders are introduced into a loam building when necessary, but sometimes the use of such material is much abused. In many instances it is far better to introduce dry sand and loam waste into cods and between the brickwork. Doubt can exist as to the beneficial use of cinders when loam-moulding certain types of castings, because one cannot always account for the poorly dried moulds when using cinders. The drying of loam is hastened very materially by perforating with the vent wire so that steam can quickly pass out. The holes so formed can be stopped up after drying.

Many more vent holes are made in dry-sand moulds than would apparently be needed just to help drying. When moulding large castings in the floor, and which are to be dried with open fires or patent driers, these holes become still more valuable.

Venting can be materially helped if, when ramming sand in the bottom boxes of large moulds, sand is fed in, after the first ram past the pattern, which is only so damp that it will barely hold together, and finish the last ram with the normal green sand.

Fig. 7.—Cast in Ganister. × 250 dias.

Venting in green or in dried moulds is usually more thorough than when working in loam or dry sand. Any neglect may prove disastrous because the gases are generated in greater volumes, the sand is weaker in bond, and the rapidly-expanding gases push off a portion of the face of the sand. If the sand face is not so detached the gas may flow into the metal and cause, if not distinct blow-holes, porosity. Unequal distribution of moisture in green sand may prove fatal to the casting. Gases may pass through correctly-mixed facing sand to encounter wet places in the backing sand, and then return again to find lodgment in the metal or blow off the surface of the mould.

The quantity of gas given off by cores and certain portions of the mould is much greater than in a similar amount of sand forming part of the mould generally, and proves very exacting on the vents. In the mould, the gas which has been liberated and expanded by the heat of the metal, is cooled somewhat when passing through the back sand, but with cores the heating up is more rapid and intense, and gases continue to generate and expand, and the core, if of comparatively small area, may be heated up to the temperature of the metal just before setting.

The average voids formed around the sand grains is stated to be about 40 per cent. of the bulk. This means that the air in the pores of the sand is also expanded, but much of it begins early to pass out through the vents. Later reactions take place between the oxygen in the sand void and oxygen liberated from the iron oxide in the sand with gases from decomposition of the carbonaceous materials. The burning out of such materials makes the sand more porous.

Vents as large as practicable should be provided to allow the gases to pass out quickly instead of blowing out through the skin of the core into the mould. The smoothing of the surface of the sand and application of refractory wash or powder helps to close up the surface pores and prevent this happening.

Moulders and coremakers often pay scant attention to vents. They will place cinders in various parts of the core or mould and leave them unconnected and isolated without separate exits for gas. Vent pipes and holes in cores, although ample in the first place, are very often seriously reduced in area when the moulder is providing a passage for the core vent through the mould.

(To be continued.)

The Making of Thin Section Patterns.*

By T. W. Markland.

Making Pattern First in Plaster of Paris.

For thin work a primary pattern is made in plaster of paris. For this purpose a piece of sheet zinc is formed into a strickle the design of the pattern required, the first one representing the shape of the back of the pattern. The second strickle, of course, will be larger, in proportion to the thickness of the castings required. These strickles are then screwed to a strong piece of wood for reinforcing. Then a board is procured (Fig. 1) and the strickle made to slide along the edge of the board to keep it in the same position all the time of using. Plaster of paris is then mixed with water to a suitable consistency and placed on the board to the required height. The first strickle is now brought into action whilst the plaster is soft, being drawn along the board,

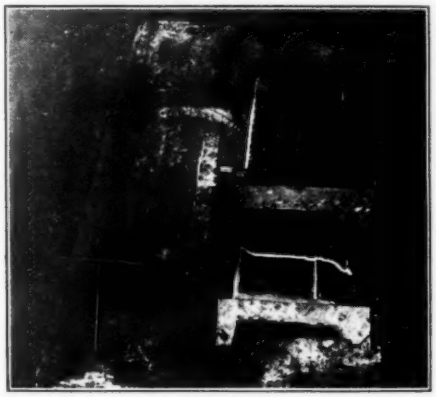


FIG. 1.

leaving the required design in plaster for the pattern. This is allowed to harden and dry. The surface is varnished with shellac, and allowed to dry. Afterwards it is covered with a thin coating of tallow.

More plaster is mixed and laid on to the present dry and varnished portion. Then the second strickle is drawn along the board, and leaves behind it only the plaster that gives a pattern of

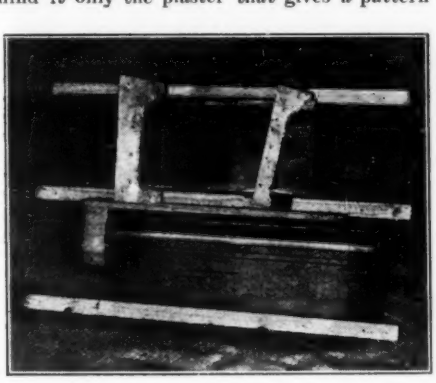


FIG. 2.

the required thickness. After hardening, the top portion may be lifted off, leaving the plaster pattern required (Fig. 2). From this a "tin" or iron pattern is prepared. For the "tin" pattern an alloy made up of three of lead to one of tin is used. The tin sections (Fig. 3) are made in lengths convenient for moulding purposes, and are soldered together and then mitred to form the working pattern. The pattern is placed upon a board in such a way that the moulder, when ramming up the bottom box containing the pattern, will not in any way alter the shape. The tin alloy is used because thin section castings are very troublesome on account of the camber needed for straightening, and the tin alloy allows the pattern-maker to introduce the correct camber (Fig. 4).

Other advantages of tin-alloy patterns are that they can be chased up quite smoothly, thus ensuring a smooth iron pattern, and that they can either be cut down to smaller dimensions or increased in size by soldering a piece to the original pattern.

Reversing Thin Section Patterns.

Fig. 5 shows the pattern for a model of a liver. This was first made by a sculptor and received in the form of plaster of paris. This plaster pattern is 1 in. thick, flat on the back side, and the liver pattern on the front, but for use in the foundry it has to be 3/16 in. thick. The moulding box used for this purpose is planed on the edges of

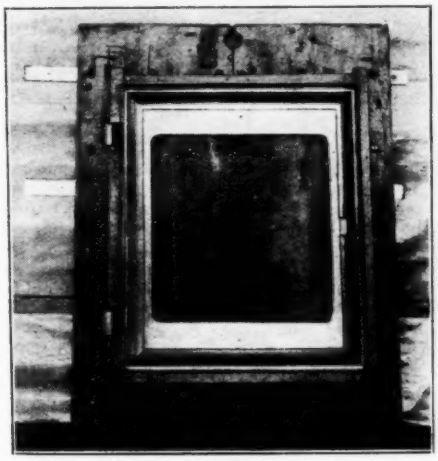


FIG. 3.

the top and bottom part so as to give a close and exact fitting of the moulding box. A turning-over board, which must be level and out of twist, is required. The plaster pattern is placed on the board and set between small pieces of wood so that the pattern can be placed exactly in the same position every time, as shown in Fig. 6. The bottom box is then placed over the pattern on the board, and at each corner of the box pieces

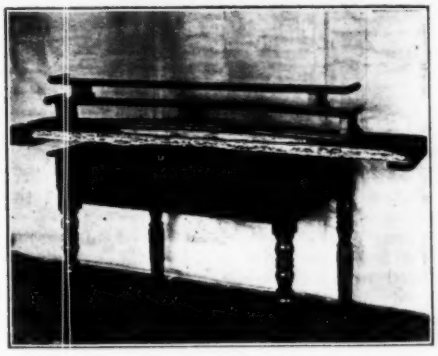


FIG. 4.

of wood are screwed on to the board to prevent the box from getting out of position, thus enabling the operator to replace the box in the same position each time required.

A thickness piece is inserted between the box and the board of the necessary thickness of the casting. The plaster being 1 in. thick, pieces 1 3/16 in. thick are placed under the box edge. Sand is sieved on to the pattern, and the box filled with sand in the usual way, but the sand must be

* A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. R. A. Miles presiding.

rammed hard so as to get a hard surface near the pattern. After clamping the box and board together, they are turned over on to a definitely level bed, but before removing the board the box is twisted about from right to left to ensure that it is quite solid on the sand floor. Then all clamps are removed, and the box is lifted off the board.

All the sand is levelled to the edge of the box and the plaster pattern, making sure there are no soft places. After smoothing with a trowel, the plaster pattern is withdrawn (Fig. 7). Using fine parting sand or foundry parting, the mould is dusted through a fine bag on to the joint. The

FIG. 5.

top box is then placed on to the bottom part and the down gate fixed in position. After sieving on the facing sand, the box is filled up to the required height with black sand; when the box has been rammed up, the top is cleaned and the down gate removed. The top box, which will now have an impression of the bottom part of the mould, is removed and placed on one side, the mould being finished in the usual way.

After removing all the sand from the bottom box, the turning-over board is placed in position as in the first process (Fig. 6), placing the pattern on the board between the templates. The bottom box is put on the board exactly in the same position as before, but instead of placing 1 3/16-in. thickness pieces under the box edge, 1-in. thick-

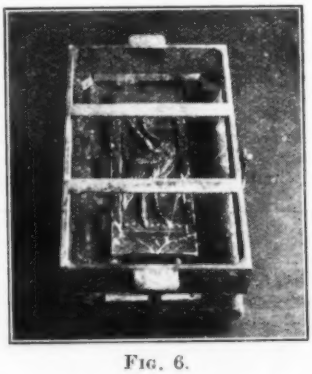


FIG. 6.

ness pieces are used, thus giving a casting 3/16 in. thick.

Facing sand having been sieved on and the mould filled up with black sand, the box is rammed up in the usual way. All loose sand is scraped off, the box and board are clamped together, and turned over on to a level bed, twisting the box about as in the previous case. The excess sand is removed down to the level of the box edge, and the joint is smoothed. Then the plaster pattern is withdrawn in the ordinary way. This gives a front and back impression (Fig. 8), and the gates can be cut and the mould finished off. The top box is replaced on to the bottom, and when cast it will give a casting 3/16 in. thick.

Making a Plate Pattern.

For this purpose a box sufficiently large to make a joint round the plate frame is used, and spaced to make the gates. The top and bottom boxes must have planed edges so as to give a close and level jointing. Well fitting box pins are essential. They must be straight, so as to give no twist in the box.

The top box is placed on the floor with the planed edges uppermost. The box is rammed up with black sand, levelled with the box edge, thus ensuring a level surface, or, alternatively, turning-over board must be used.

The pattern to be plated is placed in position, using the frame as a guide. Any projection which may be on the pattern must not come in contact

FIG. 7.

with the box bars. This, unfortunately, has happened, and plates have had to be remade.

Once the pattern is in position the facing sand is sieved on the bottom box, then placed on, and the mould is rammed up in the usual way. All loose sand having been scraped off level with bottom of the box, the job is well vented all over the bottom part.

Then a level bed is made on the sand floor, the box is well clamped together, and turned over on to it. The clamps are removed and the top box or board lifted off. Then the joint of the mould round the edge of the pattern can be commenced. This is probably the most important part of the job.

In making the joint, care must be exercised that where the frame has to lie on the mould, it must be perfectly level and out of twist, otherwise trouble may arise when the pattern filers

FIG. 8.

have to do their part of the work. Having made a good joint and ascertained that the plate frame fits exactly, the sand is smoothed with a trowel, brushed and covered with parting sand.

Facing sand and black sand are sieved over the pattern and joint to such a thickness that when the top box is placed on, the bars of the box will press into the sand and prevent any soft places under the bars.

The empty top box is returned, ascertaining that all the down gates are in position. It then remains to fill up with black sand, to ram up in the usual way, to scrape off all sand level with the bars, to clean round all gates and risers, to vent well, and finally to lift off the top box.

Before removing the pattern in the bottom box the frame which has formed the plate (Fig. 9) is

placed firmly on the joint of the mould in its correct position.

The joint is made all round the frame to its frame thickness. As the sand is now ⅜ in. higher than the box edge, there is a danger that when the job is cast the metal may burst out at the sides. To prevent this, thin pieces of sheet iron 1½ in. deep are inserted round the inside of the box and allowed to stand up just the thickness of the plate-frame.

When the joint has been made all round the frame and to the box edge, ascertaining by means of a straight edge all is level, the top box is replaced. The box is then rammed all round where the plate frame is to ensure a close joint. After removing the top box, all gates and risers

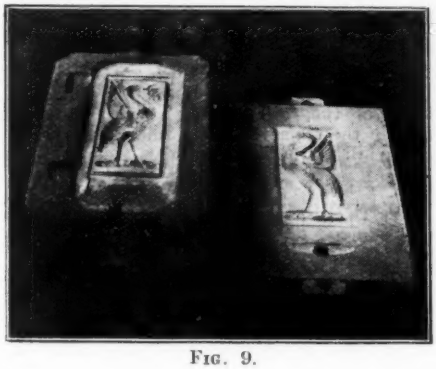


Fig. 9.

are cut to the plate. The risers serve the dual purpose of carrying away any dirt that might be flowing about and alleviating the strain. Additionally, all gates to the pattern lying in the bottom box must be cut. The frame is then withdrawn and chipping pieces inserted in the mould just where the plate rests on the edges of the moulding box. These chipping-pieces are to facilitate the chipping of the plate into the box by the pattern filer. Then the pattern is withdrawn and finished with as little tooling as possible.

The mould is dusted over with good plumbago, and the pattern is then replaced in the mould to make firm the plumbago and give the mould a smooth surface after the pattern is withdrawn; no tools are used, which promotes a perfect mould.

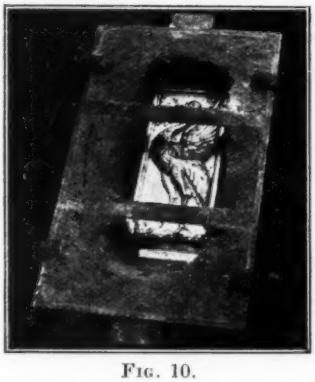


Fig. 10.

Before replacing the top box on to the bottom box ⅜-in. pieces are placed on the corners of the box, so that when the boxes are brought together and clamped up there is no fear of the plate being thick and thin. Before finally closing the mould a hot plate is held over the bottom part of the mould to give it a little skin-drying; this is to give the delicate projections a better chance of withstanding the action of the molten metal when flowing over them. This part-drying is done just before the time for casting; the mould is then closed, the box clamped together and cast at once.

The temperature of the molten iron should be at the heat which will run the finest parts of the mould sharp. After casting some little time is allowed to elapse, after which the box is turned up on its side whilst remaining clamped together (Fig. 10). Then that part of the pattern plate which has the thickest portion on it is made bare by removing all sand with a scraper, and leaving all other portions of the plate covered with sand. All is left till the following morning to cool (Fig. 11). For this particular job eleven minutes is allowed from casting to baring.

A Few Hints on Camber.

In making a standard pattern and a working pattern, and a casting from the working pattern, it should be done by the same moulder, and as far as possible when the job is cast the metal should be of the same heat every time, or different results will be given.

When a pattern has been plated and it is ready to be put into service every moulder will not give

Fig. 11.

the same results, because no man rams with the same pressure, and therefore more or less camber is needed.

The runners on thin section castings make a great difference respecting camber. A mantel leg run on the sides causes the leg to camber sideways. To overcome this, the standard pattern is run on one side and the plate casting on the opposite side, thus ensuring a straight leg.

London Foundrymen Visit Portsmouth.

Last Saturday a party of about forty members of the Institute of British Foundrymen and their ladies visited Portsmouth. The morning was spent in the foundry of the Royal Dockyards, where Mr. J. H. Coveney, the foundry foreman, explained to the visitors the features of the pattern shop, the iron, steel and brass founders, and chemical laboratory. In the steel foundry a 30-cwt. electro-metals furnace was seen in operation. After luncheon the party was shown over the "Centurion," a modern battleship, and later, Capt. Scott's ship, "The Discovery," which was refloated last Monday by Mrs. L. S. Amery, the wife of the First Lord of the Admiralty. It is fitted out as a research ship, and is primarily to investigate whale breeding round by the Falkland Islands. A very enjoyable day was spent, and during tea Mr. V. C. Faulkner, the retiring President, expressed the indebtedness of the Branch to Mr. B. F. Sperring, a local foundry owner, who had carried out all the arrangements. He also thanked Mr. Davis, also a local foundry owner, who had collaborated with Mr. Sperring, and Mr. Coveney, who had taken care of them during their visit to the dockyard. Mr. G. C. Pierce, in seconding, reminded members that Mr. Sperring was one of the oldest members of the Institute, and had only missed two annual conferences since its inception some twenty-one years ago.

Replying, Mr. Sperring said that the London Branch could rely upon the fullest measure of support from its Portsmouth members if ever a conference should be held in London.

The general arrangements were in the hands of Mr. H. G. Sommerfield, the Branch Honorary Secretary.

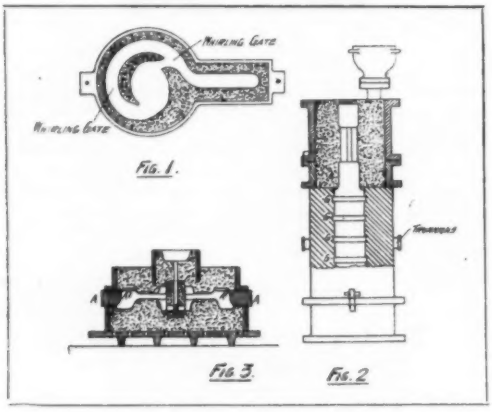
The Manufacture of Chilled Castings.

By Vallishe.

[This article is given as a reply to the Query of "Still Unchilled," which appeared in our issue of May 7.—Ed.]

Difficulties Encountered in Making Chilled Castings.

It is well known that the manufacture of chilled castings has cost founders more money, time and labour to bring their practice to a successful standard than any other branch of founding. The chief difficulties encountered were in obtaining chills of the right depth and shape, the factors affecting these being the nature of the metal used in the casting, the temperature of the molten metal entering the mould, and the thickness of the iron mould. Let us first consider the nature of the metal to be used in making the casting. This, of course, varies according to the class of casting required. Castings for "heat wear," *i.e.*, rolling-mill rolls, have to stand the effects of severe expansion and contraction, whilst castings for "friction wear," *i.e.*, the tread of wagon wheels, brake-blocks, etc., require much more "life" than the former. A chill produced by manganese is far better than one produced by sulphur, for the former class of casting. The latter class, however, requires a chill produced by sulphur, as this gives more life to the nature of the casting, than would be the case if a chill produced by manganese were used. The iron used for casting must contain a



fair percentage of scrap, consisting of chilled castings such as chilled rolls, brake blocks, plough points, wheels, etc., mixed with pig-iron. For very deeply chilled rolls the following mixture has much to its credit:—Frodingham white iron, 30 per cent.; Grazebrooke cold blast, 30 per cent.; Barrow hematite No. 4, 18.6 per cent.; Apedale (No. 5) No. 4, 21.4 per cent.; or a chemical analysis of: Silicon, 0.84; sulphur, 0.071; manganese, 0.285; phosphorus, 0.547; combined carbon 0.61; graphite carbon, 2.45; and total carbon, 3.05 per cent. For chilled wagon wheels, brake blocks, etc., the analysis should read:—Silicon, 0.80; sulphur, 0.13; manganese, 0.306; phosphorus, 0.364; combined carbon, 1.06; graphite carbon, 2.36; and total carbon, 3.42.

To put down a definite temperature for the metal when about to enter the mould is, of course, impossible, as this depends on the type of casting required and the type of chill used. Taking it that the thickness of the iron mould or chill used is the same in each case, a casting poured with hot metal will chill deeper than one poured with dull iron, and a heavy casting will chill less than a light one. In making chilled castings it may here be said that charcoal iron is now very seldom used, anthracite iron and coke being used on account of the selection of iron by analysis being now a common practice.

Construction and Thickness of Chills.

Chills intended for rolls should be long in body and cast in sections with faced flanges, as an air-tight joint is definitely necessary. Openings at these joints would be sure to cause chill cracks, thus spoiling and probably "scrapping" the casting. Sometimes it is practicable to make the chill in one piece, and in this case a considerable advantage is gained over the former method. The inside surface of the chill should be turned true and finished smooth in the lathe, great care being taken in preventing the finished surfaces from rusting through exposure to dampness. When not in regular use it is advisable to coat the chills with good grease, which of course must be thoroughly rubbed off before using again. The thickness of chills depends directly on the thickness of the body of the casting. Precaution must be taken to provide a body of metal sufficiently large to take up heat from the molten iron and thus chill the surface of the casting, and also to prevent the chill itself from cracking when suddenly heated. The latter is a common occurrence, which could easily be avoided if the thickness of the chills were more carefully considered. Below is given a reliable table (Table I) of the thickness of chills for rolls. For rolls over 9 ins. dia. it will be noticed that an increase of $\frac{3}{8}$ in. in the thickness of the chill is allowed for every inch increase in the diameter of the roll. This is to prevent the chill from cracking when suddenly heated.

Table I.—*Chill Depths of Rolls.*

Dia. of roll in inches.	Thickness of chill inches.	Dia. of roll in inches.	Thickness of chill inches.	Dia. of roll in inches.	Thickness of chill inches.
4	2	13	$4\frac{7}{8}$	22	$8\frac{1}{4}$
5	$2\frac{1}{4}$	14	$5\frac{1}{4}$	23	$8\frac{5}{8}$
6	3	15	$5\frac{5}{8}$	24	9
7	$3\frac{1}{8}$	16	6	25	$9\frac{3}{4}$
8	$3\frac{1}{2}$	17	$6\frac{3}{8}$	26	$9\frac{3}{4}$
9	$3\frac{3}{8}$	18	$6\frac{1}{4}$	27	$10\frac{1}{8}$
10	$3\frac{1}{4}$	19	$7\frac{1}{8}$	28	$10\frac{1}{2}$
11	$4\frac{1}{8}$	20	$7\frac{1}{2}$	29	$10\frac{5}{8}$
12	$4\frac{1}{2}$	21	$7\frac{7}{8}$	30	$11\frac{1}{4}$

Preparation of a Mould for a Chilled Roll.

For a chilled roll mould always use dry sand, and ram, vent, finish and dry in the same way as an ordinary dry-sand roll. Better results are obtained if the surface of the chill is heated in a stove to a temperature of from 120 to 200 deg. F. (48 to 90 deg. C.) before closing the mould for casting. The shock of the molten metal is then not so great as would be the case were the chills cold. It is always advisable to cover the inner surface of the chill with a thin coating of French chalk, powdered finely and mixed with paraffin. Great care must be taken in doing this, as the use of a material capable of producing gas would probably make the casting a defective one. Gas being created, the metal would be thrown back from the face of the chill, as it rises in the mould, the result being rough and cold-shot spots on the surface of the casting. In the moulding of chilled rolls it is important that whirl gates be attached to the mould, so that when the metal enters the mould it attains a whirling motion. This causes all the dirt to gather in a body in the centre of the casting, thus bringing it up into the top feeding head. The chill is thus given a face free from scum or dirt. If whirl gates were not used, dirt holes and other defects would be formed on the outer body of the casting, thus condemning it. Fig. 1 shews the arrangement of these whirl gates.

The runners and pouring basins should be made of dry sand, and then black-washed in the same manner as the mould itself. Much trouble is saved and a more solid casting ensured if the feeding head is made the same diameter as the roll, so that it can be cut off in the lathe when machining the casting. Chilled castings should, whenever possible, be left in the mould until they are practically at atmospheric temperature.

Difficulty Encountered in Casting Wagon Wheels.

Considerable difficulty is encountered in casting wagon wheels, the difficulty arising in obtaining an even depth of chill all over the tread. Fig. 2 illustrates a method which has attained great success at a well-known foreign foundry. The grooves *G* compel the casting to remain central in its mould, and allows the chill to have the same cooling effect all over the body of the casting. Further precaution is taken by grooving and fixing the

parts of boxes or chills that hold the bottom and top necks so that they cannot move from their connections with the chill. The sand should be of solid character, so that none or little burning action can occur to permit the bottom or top necks of the rolls to move out of their position.

Making Chilled Railway Wheels.

Though the general practice in Great Britain is to make railway-wheels of medium steel, it is of considerable interest to learn how they are made in chilled cast-iron practically throughout the United States. In this section the Americans have, indeed, obtained a high standard of perfection. Fig. 3 shows a rough section through the mould. In casting chilled railway-wheels it is extremely important that an even depth of chill be obtained. To ensure this, "contracting chills" are used. These form a sure contact with the casting, for as the wheels contract the chill closes in with it. Solid chills are generally used, ranging from four to five inches thick. and have trunnions cast on them for handling purposes. The cope C and drag D are guided centrally with the chill by means of dowel pins and plates. The chill A^1 on the tread of the wheel should be from $\frac{1}{2}$ to $\frac{3}{4}$ in. in thickness. It is, of course necessary that the metal should be very hard to withstand the wear of railway service. Experience alone is the only reliable guide to the mixture of the metal to be used for this type of casting. After being allowed to set, the wheels are removed from their moulds and placed into annealing pits in lots of ten or more. Here they are left for about three days, and then taken out and thoroughly cleaned. Annealing relieves the wheels of internal strains, thus preventing cracking when in use. The wheels are generally inspected in batches of fifty, and providing the first wheel picked out passes the test, the whole batch is accepted. Should the first wheel picked out be condemned, a second one is tried, and should this one prove to be the same as its predecessor, the whole batch is removed to the scrap heap.

New Non-Ferrous British Chemical Standard.

We are informed that the first of a series of non-ferrous standard analysed samples has just been issued, having the following percentage composition:—

WHITE METAL "A" (LEAD-BASE).

Lead	82.58
Antimony	12.05
Tin	4.64
Copper	0.34
Iron	0.07
Bismuth	0.03
Arsenic	0.06
Zinc	0.08
	99.85

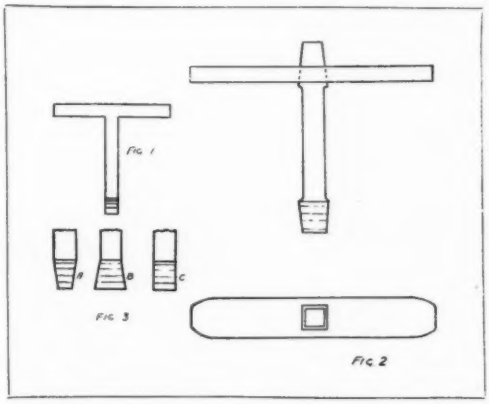
The standard has been prepared by a novel method to ensure homogeneity to meet the need of chemists who wish to check the methods they use for the analysis of lead base alloys, such as bearing metal, terne metal, stereotype metal, magnolia metal, hard (antimonial) lead, tea lead, plumbers' solder, stuffing box alloys (metallic packing), "lead wool," etc. The difficulties encountered during standardisation emphasised the need for and value of such a standard.

As usual, the analyses have been undertaken by a number of chemists having special experience in this class of alloy—*e.g.*, referee analysts, manufacturers, users, and Government Departments, including the Research Department, Woolwich, and the Bureau of Standards, U.S.A. The standard is available to anyone at a price based on covering the cost of preparing and issuing it. The three usual sizes of 50 g., 100 g., and 500 g. are provided, and a certificate (first edition) giving the names of the analysts collaborating and their analyses, is furnished with each sample. In a later edition an outline of the methods employed will be included and sent on request in exchange for the first edition. For further particulars apply to the headquarters, 3, Wilson Street, Middlesbrough.

A Note on Screwdrivers.

The screwdriver or "turnscrew" may almost be described as the universal tool. Every kind of craftsman employs the screwdriver. Among woodworkers, the patternmaker uses it more than cabinetmaker or carpenter, and it may be truthfully considered as an invaluable addition to the moulder's kit. Most patternmakers have at least three screwdrivers in addition to the brace, but the moulder is usually satisfied with one, and that a small one. His use for it is chiefly to extract screws that hold loose pieces, and it may be necessary to take out a 3-in. or 4-in. screw in a very small space. The usual procedure is to loosen off as much as possible before starting to fill a mould, but screws are frequently forgotten through not being properly indicated, or because they have been countersunk and the wood almost covers the head. The best form of moulder's screwdriver, in the writer's opinion, is one shaped like Fig. 1, made of good steel. A well-tempered screwdriver is a treasure, as so many are brittle hard and snap, while others are soft and the edge turns.

A very handy screwdriver, when there is room to use it, is formed by a screwdriver bit with a loose handle. This type of tool is seldom seen,



but for heavy screws, where there is not room for a large driver of the ordinary wooden-handle type, it is extremely valuable. The handle can be made by any blacksmith, and the hole should be tapered to fit the tang of the bit.

In regard to the orthodox form of screwdrivers, the spindle type of driver is not any better than the long, tapered blade, but it is neater and lighter, which is a consideration. In grinding screwdrivers, the mistake is often made of making the edge too fine. Even if the edge does not break when very fine, it spoils the head of the screw, because there are only two points touching. The ideal edge is one that fills the slot completely, but this cannot be obtained when all gauges of screws are being used. A driver that fits a No. 10 screw has the greatest general usefulness.

A point of contention is whether a screwdriver-blade should be parallel or tapered. At A, Fig. 3, is shown a blade tapered narrower at the edge; the disadvantage of this is the tendency to countersink the screw-heads much deeper than is necessary, although, on the other hand, it is very useful when taking screws out of old patterns when the fibre almost covers the screw-head. B shows a blade tapered in the opposite way; this is not popular because the corners are apt to tear the wood. The parallel type C is probably the best all-round tool.

Obituary.

MR. E. I. FIRTH, head of the firm of J. & J. W. Longbottom, ironfounders, Bridge Foundry, Holmfirth, died recently at the age of 60 years.

MR. ROBERT DEMPSTER, of Vale Royal Hall, Cheshire, has died at Cape Town, aged 70 years. Mr. Dempster was head of the well-known firm of R. & J. Dempster, gas plant works, Newton Heath, Manchester, and was also identified with other engineering and industrial concerns in Lancashire.

Welded Joints in Cast-Iron Pipe.

By C. H. S. Tupholme.

Hitherto the only practicable joint for cast-iron pipe, especially on underground mains, has been the bell-and-spigot type, using either lead or cement as a retainer for the yarn. Such types of joint are successful where the pressure in the pipe is moderate, say a gas pressure up to 15 lbs. per sq. in. For higher pressures, however, it has become increasingly evident that if the merits of cast-iron pipe are to be maintained, some more satisfactory type of joint must be used. The need for a better joint has led to the use of bronze welding.

In effecting this welded joint in cast-iron mains, the ends of the pipe are plain and are welded together by means of a built-up collar of bronze, the resulting pipe having the same strength as the pipe metal itself and being so flexible that mains may be welded continuously and then allowed to sag down into the trench as the jointing proceeds. The actual weld is effected by an oxy-acetylene welding apparatus, employing a special bronze of low fusing temperature.

Such a joint would not have been possible but for the introduction of the centrifugal-casting process, which produces a pipe of thinner section but greater strength than sand-cast. The pipe is lighter, stronger and the metal structure is more uniform than ordinary cast-iron pipe, which should mean the opening up of a greater field for cast-iron pipe, since it may be more easily and more cheaply handled, and at the same time retain the most desirable feature of cast iron—resistance to corrosion.

The first joints on cast-iron mains were carried out in the same way as in steel-welding practice, *i.e.*, the ends of the pipe were bronze-welded with bevelled edges. Tests on such joints showed that they were practically valueless, while experiments showed that if the two ends of the pipe were left plain, brought together, and then a collar of bronze was built up on the exterior surfaces of both pipes, a joint of extraordinary flexibility and of a strength equal at least to that of the metal itself was obtained.

Table I, for which the author is indebted to the United States Cast Iron Pipe & Foundry Company, illustrates the physical properties of the bronze (Tobin), two varieties of cast-iron pipe, and the calculated stresses to which such a joint may be subjected:—

Table I.—*Physical Properties of Materials Used.*

Material.	Tensile strength in lbs. per sq. in.
Tobin bronze	50,000
Ordinary cast-iron pipe	15,000–22,000
Centrifugal cast-iron pipe (de Lavaud)	30,000–40,000
Shearing strength of Tobin bronze to cast-iron	40,000
Maximum allowable stress on centrifugally cast-iron pipe with Tobin bronze joints	14,000
Modulus of rupture or maximum stress in bending centrifugally cast-iron pipe with bronze joint	18,000–21,000
Apparent modulus of elasticity of centrifugally cast-iron pipe with Tobin bronze joints	14,000,000

It is essential in bronze-welding, as in all other types, that the pipe surfaces be clean, and there must be no trace of oxides or other foreign matter. As a rule, the ends are rubbed clean with emery paper or brushed with a stiff wire brush. The two ends of the pipe are butted together, and a tack weld is placed in two or three spots. The pipe ends are heated by an oxy-acetylene flame to dull redness, and the bronze rod is applied at the lowest temperature at which a satisfactory bond of the two metals can be obtained.

The "ripple" form of welding has been found most satisfactory in bronze-welding, though the ripples are not defined with the same clearness as in steel-welding, because the bronze cools with a smoother surface. The bronze rod usually employed is $\frac{3}{16}$ in. dia., though larger sizes are recommended for high-capacity mains. The special bronze used is an alloy of copper, zinc and tin with from 59 to 63 per cent. copper, 36 to 40 per cent. zinc, and 0.5 to 1.5 per cent. tin. As is well known, zinc has a low melting-point, so that when welding, part of the zinc constituent is first deposited on the pipe as an oxide. At this point it is essential to maintain a neutral flame, as an excess of oxygen will oxidise the zinc content of the rod, weakening the weld and giving off disagreeable fumes. If the temperature used is too high, gas bubbles are formed by burning out a large part of the zinc, and the weld will be porous.

An important feature of this type of joint is the size of collar welded on to the pipe ends, which must be of such dimensions that the joint is at least equal in strength to the pipe. The collars in Table II have been found to be the most suitable for various sizes of centrifugally-cast pipe:—

Table II.—*Details of Collars Used.*

Diameter of pipe in inches.	Outside dia. of pipe in inches.	Thickness of pipe in inches.	Bronze collar (Tensile strength of pipe 30,000 lbs. per sq. in.)	
			Minimum thickness in inches.	Minimum width in inches.
6	6.90	0.35	0.21	0.53
8	9.05	0.38	0.23	0.57
10	11.10	0.42	0.26	0.63
12	13.20	0.46	0.28	0.69

The welding process is quite simple, and a welder with experience in jointing pipes can make good welds with bronze after several trials, the weld afterwards being broken and flattened to ascertain if a satisfactory bond between the metals has been secured. The joints should be tested for tightness by closing the two ends of the pipe and applying air under a pressure exceeding that at which the line must work.

Table III illustrates the flexibility of bronze-welded pipe, particularly that of the rigid joint.

Two specimens were subjected to impact test, one consisting of three lengths of 6-in. sand-moulded cast-iron pipe with bronze-collar joints, and the other was identical except that the pipe was centrifugally cast. One end of the specimen was raised to various heights and then allowed to fall, striking a timber beam placed transversely on the ground. Failure occurred in both cases by fracture of the pipe, the maximum elevations being 3.75 ft. and 5.75 ft. for the sand-moulded and centrifugally-cast pipe respectively. These shocks are likely to exceed in severity those incurred in ordinary handling. Both specimens showed considerable resiliency up to the breaking point. In other tests, carried out by the Line Air Products Company, a section of welded pipe was supported at the ends and a load applied at the welds, one-third the length of the pipe from the ends. A total load of 2,760 lbs. caused a deflection of 5 in. before the pipe broke.

In laying mains where bronze welds are employed, it is economical to make as many rotating welds at the side of the trench as possible, *i.e.*, where the pipe is rotated for the convenience of the operator by means of a chain pipe-wrench. The usual practice is to weld two lengths of pipe into one at the side of the trench and then to support these lengths on timbers placed across the trench. Sections of ten or more lengths are then welded together and lowered into the trench. The limiting factor in handling and laying the welded sections in the trench is that the strain shall not produce a stress exceeding 14,000 lbs. per sq. in., which is the maximum allowable on centrifugally-cast iron pipe. The maximum unsupported sections of pipe during welding must not exceed 60 ft., that is to say five lengths.

A recent installation of 6-in. pipe at Long Island

affords a typical example of the modern method of laying gas mains of cast iron with bronze-welded joints. The line was to consist of 2,000 ft. of 6-in. centrifugally-cast iron pipe. A section 1,270 ft. long was laid in one place and 700 ft. in another, the former being the first part of a 20-mile line to run gas through the centre of Long Island at 60 lbs. per sq. in. pressure. In laying these mains two 12-ft. lengths were first welded into one 24-ft. length, the weld consisting of a bronze collar over the butted ends of a straight end pipe. Fifty-three rotated bronze welds were made, using 8 cub. ft. of oxygen, 7.75 cub. ft. of acetylene, 1.1 lbs. Tobin bronze and 1 oz. of flux for each weld. The average time for welding a rotating joint was 18 min. A standard blowpipe with 67.5 deg. head was used, the filler rod being $\frac{3}{16}$-in. bronze.

Table III.—*Showing the Flexibility of Bronze-Welded Pipe.*

Pipe.	Dia. in inches.	Thickness, in inches.	Weight lbs. per ft.	Max. deflection in inches.	Max. bending moment.	Max. unit stress in lbs.
a. Sand-moulded C.I.	4	0.42	18	63	129,936	21,882
b. ,, ,, ,, ...	6	0.44	25.8	42.3	180,912	14,514
c. Centrifugally-cast iron ..	6	0.38	23.8	33.8	238,177	20,727
d. Sand-moulded C.I.	8	0.50	41.6	12.5	170,491	6,341

When the mains were laid, two 144-ft. sections were lowered into the trench and then dragged for about 70 ft. into place without damage to either the pipe or the joints. In some places a maximum deflection of 36 in. in 42 ft. was attained without any trace of fracture. Welding was continued in spite of rainy weather and a snow storm. After the 1,270-ft. line was completed, it was subjected to an air-pressure test of 95 lbs. per sq. in. Two pin-holes were detected and closed, after which the air supply was cut off and the pressure maintained for 7 hrs. The pressure fluctuated somewhat, due to temperature changes, 92 lbs. being recorded in the morning, 96 lbs. at noon, when the pipe was exposed to the sun, and 94 lbs. when the pipe was laid in the ditch and covered up. The soil conditions in this locality are exceedingly destructive, and it has been decided that cast-iron pipe is the only type which will prove serviceable. Considerable trouble is experienced with electrolysis. Work has now been put in hand on a 20,000-ft. extension of this line.

There is an increasing tendency in America to despatch cast-iron pipe to sites in lengths of from 30 to 40 ft., the pipe being bronze-welded in sections of 200 ft. to 300 ft. under continuous rotation. Where stresses are encountered due to temperature changes producing expansion and contraction, a combination of the welded and bell joints is being found satisfactory, the main being jointed every 300 ft. or so by a socket joint, the intermediate junctions being effected by bronze welding.

The quantity of bronze and flux required for various pipe diameters varies, and the figures shown in Table IV, compiled by Mr. H. Y. Carson, research engineer of the American Cast Iron Pipe Company, represents the best practice. The flux used varies, but one with the following composition has given good results:—Boric acid, 16 parts; potassium chlorate, 4; iron carbonate, 3; granulated yellow brass spelter, 32 parts.

Table IV.—*Average Quantities for Bronze Welds for Cast-iron Pipe of Different Diameters.*

Pipe diameter	2 in.	3 in.	4 in.	6 in.	8 in.	10 in.	12 in.
Average thickness of weld, in. ..	0.11	0.12	0.12	0.13	0.14	0.16	0.18
Width of weld, in.	0.75	0.80	0.90	1.00	1.15	1.25	1.35
Tobin bronze, lbs.	0.20	0.40	0.60	1.00	1.40	2.25	2.00
Flux, lb.	0.01	0.03	0.04	0.06	0.09	0.13	0.20
Oxygen, cub. ft.	2.00	3.00	4.10	7.00	10.0	12.8	18.0
Acetylene, cub. ft.	1.9	2.7	3.7	6.3	9.0	11.5	16.2
Welder's time, min.	10	15	22	25	35	45	50
Helper's time, min.	8	10	12	15	19	24	30

It is stated that negotiations for the sale of the steel works of the Glasgow Iron & Steel Company, Limited, to A. Muir & Company, 50, Wellington Street, Glasgow, have been practically completed. The works, which are situated in Wishaw, were engaged for many years in the production chiefly of ship plates and sectional material. They have been closed, however, since 1921, and are now in course of demolition. The Glasgow Iron & Steel Company, Limited, are retaining possession of the blast furnaces, cement works, and five collieries.

A Note on Saucepans.

A writer with perhaps a greater sense of humour than knowledge of the properties of metals tells a tale of a cook who successfully got a concoction into a saucepan, but could not get it out again when cooked. The extraction of the delicacy appears to have defied all efforts to dislodge it from the fastnesses of the pan, and a blacksmith was called in, no one appearing to have advised the dropping of the pan on a hard floor.

In this country the saucepan was known in medieval, and until comparatively modern times as a pipkin or skillet, the latter being the more common name.

In Murray's great Dictionary there appears the following:—

"Free from a crack or flaw of sinning,
As men try pipkins by the ringing."

The medieval saucepan stood commonly on three short feet affixed to the bowl. On the upper surface of the handle would be an inscription, and it is a difficult matter to decide when these inscriptions consist of apparently a name, whether the name inscribed is to be considered as that of the maker, purchaser, or place where the article was made.

A Saucepan Dating Back some 2,000 Years.

In the British Museum a fair number of saucepans remain, in any one of which vegetables could be cooked to-day. The oldest of these proabbly had cabbages cooked in it in Northumberland, 2,000 years ago. This is an exceptionally handsome saucepan, and it is well shown in our illustration.

Another of many centuries later date (17th century) bears the inscription:—A.V.B. LOYAL TO HIS MAGESTY. Another is inscribed:—PITTY THE PORE. 1684.

An even finer collection of skillets or pans may be seen in the metal department at South Kensington. On the handle of one is the word:—"WANBOROUGH."

In many provincial museums examples of skillits remain. At Winchester is an example of a seventeenth century skillet. This fine bronze vessel has a bowl about 7 in. deep and some 8 or 9 in. wide, the handle being well over a foot in length. This pan has the inscription:—"X CLEMANT X TOSEAR X." The pan stands on three short feet.

Die-casting Alloys.

"METALLOID."

The alloys generally used in the manufacture of die castings may be divided up under four main headings:—(1) Lead-base alloys; (2) tin-base alloys; (3) zinc-base alloys; and (4) aluminium-base alloys.

Lead-base Alloys.

Lead-base alloys consist chiefly of lead alloyed in various proportions with antimony, tin or with both metals. When lead was first used the castings made were too soft and had too low a tensile strength to be of very much use, and the addition of tin has resulted in an improvement of the casting qualities, though such alloys have a restricted field of application.

A lead-antimony alloy of 83 per cent. lead and 17 per cent. antimony is used as a type metal and also for bearings, provided speed and pressure are not high. This alloy is unsuitable for containers for food products on account of its reaction with organic acid, though it may be used in certain cases where some resistance to corrosion is necessary. This alloy is very readily soluble in nitric acid, slowly soluble in hydrochloric, and insoluble in sulphuric. It oxidises slightly on exposure to the atmosphere though it can take a good polish; it will also nickel-plate well.

The practical limits of a lead-base die-casting alloy are:—(1) *Maximum weight* for castings, 12 lb.; *wall thickness*, 1/16-in., whilst very small sections can be cast with 1/32-in. walls; *variation* from drawing dimensions, plus or minus 0.001 in.; *maximum number of threads*, external, 32 per in. —internal ones are sometimes cast; *holes*, 0.031 in. minimum, but are regulated by depth and thickness of the casting; *draft*, cores 0.001 in. per in. of length, and side walls 0.005 in. to 0.010 in. per in.

Sections of castings of this alloy should be as large as possible, and large fillets and thin sections are most desirable within the limits given above. Undercuts must be avoided wherever possible, and inserts can often be provided to impart special features at localised points, such as strength, hardness, electrical conductivity and means of lubrication.

Tin-base Alloys.

Tin-base alloys consist of tin alloyed with copper, lead or antimony and include the babbitt metals. An alloy of tin (86 per cent.), copper (6 per cent.), and antimony (8 per cent.) is used for bearings for engines and machine parts where a high resistance to corrosion is required and low tensile-strength is permissible. This alloy does not react with organic acids, very little with either mineral acids or alkalis, and the atmosphere is without effect upon it. The practical limits of this alloy are:—*Maximum weights for castings*, 10 lb.; *wall thicknesses*, 1/16-in., whilst very small sections can be cast with 1/32-in. wall; *variation from drawing dimensions*, plus or minus 0.001 in. per in.; *maximum number of threads*, external 32 per in., whilst internal sometimes cast; *holes*, 0.031 in. minimum, but regulated by depth and thickness of the casting; *draft*, cores, 0.001 in. per in. of length and side walls, 0.005 in. to 0.010 in. per in.; *physical properties*, silver white colour; *specific gravity*, 7.4; *weight* per cub. in., 0.226 lb.; *melting point*, 230 deg. C.; and *initial fusing point*, 212 deg. C.

Zinc-base Alloys.

Zinc-base alloys are commonly composed of zinc with tin, copper, aluminium, nickel or chromium, or a combination of several of these metals. Zinc-base alloys are easily plated with the usual materials, and it will solder readily. It should not be used where the part is subject to severe strain or sudden shock. Zinc-alloy die castings will corrode under moist atmospheric conditions, and they are also subject to slight deterioration due to crystalline growth. It is soluble in mineral acids and alkalis. The main uses of this alloy are in magneto frames, calculating and similar machinery, gramophone parts, and some motor-car accessories. The practical limits of an alloy of 88 per cent. zinc, 8 per cent. tin, and 4 per cent. copper are: *Maximum weight of castings*, 10 lb.; *wall thicknesses*, 1/10-in., but with small castings 1/16-in.; *variations from drawing dimensions*, plus or minus 0.002 in. per in.; *maximum number of threads*, external 24 per in., whilst internal ones are sometimes cast; *holes*, 0.031 in. minimum, but regulated by depth and thickness of the casting; *draft*, cores, 0.005 in. per in. of length (extremely long cores require greater draft); *side walls*, 0.005 to 0.010 in. per in.; *physical properties*, colour silver white; *weight* per cub. in., 0.253 lb.; *melting point*, 415 deg. C.; *initial fusing point*, 135 deg. C.; *tensile strength*, 7.1 tons per sq. in.; *elongation*, 1 per cent. in 2 in.; and *hardness*, 53 Brinell.

When alloyed with aluminium and copper, the tensile strength is doubled, and both elongation and hardness are higher. This alloy is stronger than the first, but is not so easy to plate, and is only soldered with difficulty.

Zinc has also been alloyed with nickel and chromium for die-cast parts under a patent. The properties are substantially the same as the first zinc alloy mentioned, but this patented alloy does not "age." The only effect water or steam has on this alloy is the formation of a zinc carbonate in the form of a light white powder on the surface.

Aluminium Alloys.

Aluminium alloys of aluminium (92 per cent.) and copper (8 per cent.) are used for vacuum-cleaner parts, motor-car parts, gramophones, and cameras. It has also been used for crank cases, pistons, spark and throttle levers on aeroplanes. This alloy takes a high polish and retains it well: it can be nickel-plated or enamelled. The physical limitations of this alloy are: *Maximum weight for castings*, 8 lb.; *wall thicknesses*, 1/16 in. for small castings and $\frac{1}{8}$-in. for larger castings; *variations from drawing dimensions*, plus or minus 0.0025 in. per in.; *maximum number of threads*, external 24 per in. (limits on threads plus or minus 0.004 in.)—internal ones are not cast; *holes*, 0.093 in. minimum for holes not more than $\frac{1}{8}$ in. deep. Larger diameter holes can be cast deeper in proportion, whilst small holes can be spotted to facilitate drilling; *draft*, cores, 0.015 in. per in. of length: cores less than $\frac{1}{4}$ in. in length have 0.005 in. taper), side walls 1/64-in. per in.: *physical properties*, colour silver white; *specific gravity*, 3.003; *weight* per cub. in., 0.115 lb.: *melting point*, 620 deg. C.; *initial fusing point*, 550 deg. C.; *tensile strength*, 9.3 tons per sq. in.: *elongation*, 1.5 per cent.: *compressive strength*, 12.5 tons per sq. in.: and *hardness*, 60.5 Brinell.

This alloy is soluble in dilute sulphuric and hydrochloric acids, soluble in alkalis, slightly soluble in concentrated hydrochloric and sulphuric acids, and insoluble in nitric acid. There is little reaction with organic acids and no reaction with the atmosphere.

Die-cast parts of aluminium, copper and nickel are somewhat softer, tougher and more ductile than those discussed in the previous paragraph. This is another patented alloy.

Aluminium has also been alloyed with silicon and is used where a copper-free, aluminium-alloy is desired as in rubber vulcanising practice. This is the lightest aluminium alloy made and weighs only 0.095 lb. per cub. in. It has a tensile strength of 12.5 tons per sq. in. and an elongation of 2.5 per cent., with a hardness of 50 Brinell.

Copper-base Alloys.

Copper-base alloys, consisting of copper and zinc, give die castings which can be readily plated, soldered or brazed. Due to the high melting-point and solidification shrinkage, casting limits cannot be held as close as those made from zinc, tin, lead or aluminium alloys. The practical limits for this alloy are as follow:—

Maximum weight for castings, 14 lb.; *wall thicknesses*, 3/64-in. on small castings; *variations from drawing dimensions*, plus or minus 0.005 in. per in.; *threads*, not cast; *holes*, $\frac{1}{4}$ in. minimum (smaller holes can be cast in thin sections or spotted to facilitate drilling); *draft*, cores from 0.005 in. to 0.010 in. per in., side walls, 0.002 in. per in.; *physical properties*, colour golden yellow; *weight* per cub. in., 0.31 lb.; *melting point*, 955 deg. C.; *initial fusing point*, 898 deg. C.;

tensile strength, 26.7 tons per sq. in.; *elongation*, 20 per cent.; *compressive strength*, 38.3 tons, and hardness, 100 Brinell.

The success met with in the die-casting of tin, lead-zinc and aluminium-base alloys have encouraged attempts to produce die castings from brasses and bronzes. Bronze castings have been produced and have proved satisfactory, but the cost has been too high, due to the very short life of the die. This difficulty has now been overcome by the use of a plastic non-metallic die which produces bronze die castings of intricate design and sharp and detailed edges.

The bronze used for die castings usually has a tensile strength of around 26.7 tons per sq. in., the elongation being 20 per cent. on a 2-in. bar. This alloy has the same good machining qualities as soft extruded or bar brass. There is no crust to be contended with to dull cutting tools. The uniformity of the surfaces permits greater speed and better results. The tensile strength may be increased to 31.2 tons per sq. in. when necessary, the increase in strength being accompanied by increased toughness. The elongation may be increased to 40 per cent. when necessary. The hardness of the alloy may be varied through a range of 40 to 100 Brinell, the harder alloys having excellent bearing qualities and is particularly suitable for ball and roller-bearing retainers. Where two parts bear on one another, one part may be made from the softer, and the other from the harder, alloy. This practice has given excellent results in spur, bevel and spiral gear-drive construction.

The bronze alloy may be polished to a high lustre, and when so polished is a bright gold colour, which it will retain for a long period under ordinary atmospheric conditions. These die castings, though corroded by salt water, will withstand such action better than the yellow brasses, and their behaviour under such conditions compares favourably with that of manganese bronze.

The Selling of Castings.—XII.

By VOYAGEUR.

When a firm has decided to inaugurate a publicity or advertising department of its own various problems arise which require careful consideration, and in their solution the experience of others may be of inestimable service. It is the proposal of the present article to discuss the more general of these problems, and to show how they may be dealt with satisfactorily.

The first and most essential step, once the sales department, or business head, or board of directors of a firm has taken the matter in hand, is to appoint an advertising or publicity manager. There are two ways in which to find the right man. The first, easiest, and most immediately efficient is to advertise for an experienced man to take charge of and set going the whole department. The disadvantages of this course are that an experienced man requires high remuneration based on the length and nature of his experience, and that unless he is already acquainted with the particular trade or product of his new employers, he will have to set to work to become familiar with it and with the markets for it.

The second course, and ultimately, if successful, the most profitable, is to select a likely member of the existing office or managing staff, give him the required training, and eventually allow him to take charge and gradually "feel his feet." The advantages of this method are: (1) He will be ambitious and eager to prove his ability; (2) his remuneration will not need to be so high, his experience being less; and (3) he will already be acquainted to some extent, varying with the nature of his previous occupation, with the uses of and markets for the product. The disadvantages are: (1) A certain sum will have to be expended on his training before it can be definitely known whether or not he is fit for the post; (2) his lack of experience even after training may impair his efficiency; and (3) he may prove a total failure.

Now it does not often happen that the right man is to be found as a member of the existing organisation, but it happens more frequently than might be expected.

The embryonic advertising manager must, for preference, be on the right side of forty. He must, above all things, have the gift of self-expression, both in writing and in speech if possible, but certainly and essentially in writing. He must be quick-witted, mentally alert, and full of ideas, even heterodox ideas. He need not be mathematically minded, but he should be systematic and careful, and should have a good memory. Finally, he should be conscientious, because only a conscientious man will write convincing advertisements. The "plodder" will never make a really good advertising man. If one other asset may be mentioned, it is desirable that he should have a certain amount of tact, because he will frequently have to rely upon others for information, and will, at any time perhaps, be required to take an important part in conferences connected with sales.

The advertising manager must, then, be able to write good "copy." He must understand the technicalities of printing and block-making sufficiently well to be able to order printing and blocks as economically as possible. He need not necessarily be able to make finished drawings, but it is an advantage if he can draw well enough to indicate his ideas to a professional artist or lay-out man. He should have an eye for balance and attractiveness in a lay-out, if only so that he may pass judgment upon the lay-out man's work. In the same way he should have an eye for colour, and some theoretical knowledge of colour combinations and values; and, in addition to all this, he must know the theory of advertising from A to Z, including the designing of all forms of publicity, the editing of house organs, the planning of campaigns, the analysing of market conditions, and so on.

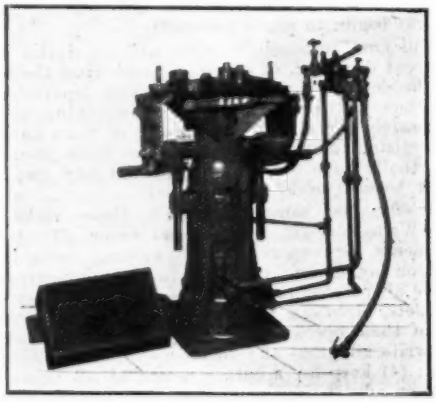
The experienced advertising man will, of course, have most of this stuff at his finger-tips. The novice fresh from the staff can only acquire it by tuition, patient application, and eventually by constant practice. The selected man whose existence we have postulated should be "apprenticed" for a time to some advertising agency or consultant, where he may become familiar with publicity technique of all kinds. He should then spend some time at a printing works, and later at an engraver's. During all this time of training he should read as many books on the subject as he can get hold of, beginning with the more elementary, and gradually working up to more advanced theory. According to his initial receptivity and brightness, he will in due course—it may be a few weeks, it may be months—be ready to make some sort of a beginning in his new post. It will then be as well if either one of his employers who understands advertising conditions, or the advertising agent with whom he has worked, exercises supervision over his early efforts until he has begun to prove his ability.

And now, to conclude, what will his duties be? A great deal will, of course, depend upon the size of the department he controls. New departments are, however, usually small in the beginning, so we can safely throw a greater volume of work on the advertising manager in this case than he may eventually have to perform. But in any case he must be *able* to do it if necessary.

Briefly, he must fulfil all these tasks:—(1) Write, design, lay-out, and order all advertisements, or supervise their writing, designing, and/or laying-out; (2) write, design, lay-out and order all printed matter in the form of catalogues, booklets, circulars, pamphlets, or supervise any or all of these operations, edit house organs, if any; (3) write all form- and follow-up letters, or supervise; (4) keep an accurate record of all expenditure on advertising, printed matter, and circulars; (5) order blocks, drawings, photographs, etc.; (6) keep an accurate record of all stocks of literature, blocks, etc.; (7) keep an accurate record of orders, inquiries, etc., resulting from advertisements, despatching of literature, circular letters, follow-up letters, and so on; (8) prepare statistics showing relation of publicity expenditure to selling costs, net sales, and so on; (9) prepare exhibits for exhibitions, etc., and (10) interview canvassers and representatives, carry on correspondence, collaborate with sales department, attend sales conferences, and so on

A New Pneumatic Jar and Pattern Draw Moulding Machine.

Our illustration shows a new design for a small jarring and pattern drawing machine, which has been designed by John Macdonald & Son, Limited, of Watt Street, Maryhill, Glasgow. There are no unnecessary complications and no working parts are visible at any time, even the side guide rods are covered with thin steel casings filled with oil, and are therefore always under lubrication. The oil-controlled pattern draw has an accelerated movement coupled with a quick return to normal, the pattern-drawing piston is of great length, thus ensuring a dead true draw. The minimum pattern draw is 2 in., the medium 4 in., and the maximum 6 in., and the adjustment from one to the other can quickly be made. In designing this machine, radial arms and lifting rods which always require spanners to adjust them to the various positions necessary for various sizes of boxes have been dispensed with; instead, there has been introduced a straight-line movement controlled by compressed air. The box lifters or adjusters are always under air pressure, therefore, if the machine operator requires the adjusters moved to suit an increased length of box he merely turns a knurled handle on either side of the machine, and the air does the rest.

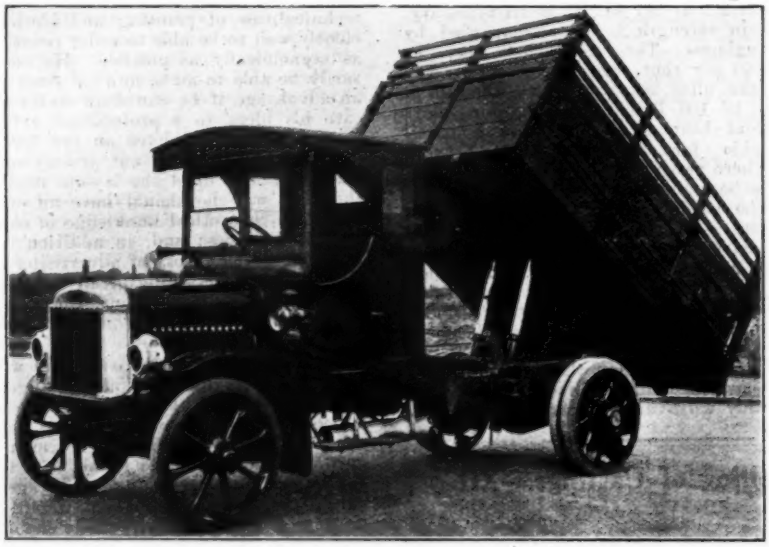


No. 1 "AJAX" PNEUMATIC JAR AND PATTERN DRAW MOULDING MACHINE.

This new machine is a compact rapid jolter; it is exceptionally strong, simple, and durable in design and construction, and is well adapted to iron, brass, or aluminium foundries for all kinds of light work. The machine will accommodate eight different sizes of boxes, the longest length being 18 in., the greatest width 16 in., the smallest box 12 in. × 12 in. The machine is fitted with a vibrator and universal control by hand, or can be arranged with special knee valve for simultaneously controlling vibrator and pattern draw.

Leyland 3-Ton Tipping Wagon.

There are several interesting features embodied in the design of this wagon, which was built by Leyland Motors, Ltd., Leyland, Lancashire. In the standard body the sides and tailboard are detachable so that the wagon may be used as a flat platform lorry; lattice extensions are also provided which enable the wagon to carry three tons of coke or similar light material. The normal body will of course hold that tonnage of coal.



LEYLAND 3-TON TIPPING WAGON.

The wagon is furnished with hydraulic tipping gear, the hoist being made with double rams. The mechanism consists of a reservoir containing a medium light oil, an oil pump with tube connections between the pump and the rams, and a suitable arrangement of valves. In the model illustrated, the drive for the pump is from the engine; in the 4-, 5-, 6- and 8-ton models the drive is taken direct from the gear box. The pump delivers the oil to each of the rams at equal pressure and on the body reaching the maximum angle of tip an automatic valve comes into operation allowing the oil to by-pass, at the same time maintaining the pressure inside the rams. To return the body to its normal position a hand-operated valve is opened, through which the oil is returned to the reservoir under pressure of the rams. The rams are of course universally supported by cross members on the main chassis frame, and are thus free to swing in any direction with the motion of the body.

The back door of the body is swung at the top and locked by means of a sliding bar with pins attached, which shoot into eye-bolts; the locking arrangement is operated by a lever placed at the near side. The side doors, as will be seen from our illustration, are also operated through a lever placed at the rear of the wagon. To unlock these doors it is only necessary to remove a pin and turn the lever.

THE DIRECTORS of the Coltness Iron Company, Limited, are offering 262,500 ordinary shares of £1 each to holders of the existing ordinary shares in the proportion of one new ordinary share for every two ordinary shares held. The new shares will not participate in any interim dividend declared prior to December 31, but any such dividend will not exceed 5 per cent. per annum. The extra capital is needed to complete the development of the company's collieries.

Discussion on Mr. F. C. Edwards' Paper on "Extending the Use of the Oil-Sand Core."

THE RETIRING PRESIDENT (Mr. Thomas Vickers) said he was rather disappointed that Mr. Edwards had not touched upon such debatable points as sands, oils and baking, which were subjects the foundryman wanted to hear more about. The essential quality required in the sand was permeability, otherwise satisfactory venting was impossible. Various kinds of sand were used in oil-sand cores, but the main feature was that the sand must have a round grain to ensure that the binders took effect. The more angular the grains the less efficient would be the binding agent. There were numerous oils and mixtures and bindings. He found that there were 31 different brands being advertised in America. There were not so many in this country, but there were sufficient to make it difficult for the foundryman to decide which was the best to use. He was surprised to hear Mr. Edwards speak rather disparagingly as regarded the use of linseed oil as a base oil. He (Mr. Vickers) would have thought it would have been amongst the best, because the question must be determined by the test of flash point. The higher the flash point of the oil the greater was its efficiency in binding quality. The flash point of linseed oil he believed was somewhere about 250. The bulk of core oils were without doubt a mixture of linseed oil or some other base oil with resin, gums, etc., and these additions having a lower flash point must make the average flash point lower. That, he had little doubt, was one of the reasons of the failures which foundries experienced in making oil-sand cores. As to baking, the oil mixture also had a determining effect, because the higher the flash point of the oil the quicker was the baking carried out.

Economies through Use of Oil-Sand Cores.

MR. F. J. COOK (Past-President), referring to repetition work, said that one of the great advantages of the oil-sand core was the speed with which the cores could be made and the safety that was attainable with them. Some years ago he was concerned with the making of cores for the waterways in turbo blowers. Using ordinary sand, it took two and a half hours to make a satisfactory core iron. The core, which was rather large, was only ¼ in. in places, and of very complicated design. The grid had to be made up and riveted and laced in many places, with the result that it took practically half a day to make it and complete the core. Making the same core with oil sand it only took twenty minutes, and it was a better core.

MR. D. WILKINSON thought everyone would agree that the oil-sand core removed a considerable number of the difficulties incidental to the ordinary dry-sand core One great advantage was the ease with which they could be handled after drying. One great difficulty he used to find in early oil-sand experiments was in adjusting one core to another after they had dried and when some slight distortion had occurred. That had been readily overcome by the use of the file. It might be said that a core should not be rubbed at all, but many castings could not be made if rubbing was not permitted. As to dryers, he said that where they were properly made and used the accuracy of the core could be retained in a remarkable degree. He remembered during the war hearing one man say that he would not guarantee a certain aeroplane casting to a quarter of an inch owing to the difficulty of the core, yet that same casting, when proper driers were used, was regularly made, and the dimensions came out to within less than a 64th of a variation. This showed that with care and accurate workmanship a great degree of reliability in regard to dimensions was attainable. One of the troubles of which most engineers complained was the irregularity of machining allowances. It was certain that if oil cores were used and properly made machining allowances could be reduced to the utmost limit.

MR. E. H. TYSON, referring to a cylinder exhibited in the room, said he thought it might be of interest to the members to see it as illustrating what could be done with oil-sand cores. That particular job, he explained, was built up from the crown to the bottom fin in separate cores. Of course, it would have been almost impossible to have made a mould of the job and expect the fins to run because of their depth. Some of the cylinder fins were 2¾ in. deep. The advantage of building up a job of that description was that with the oil-sand core if the cores warped at all it was easy to put them on to a flat plate and give them a tap with the hand and straighten them.

MR. W. BAKER, alluding to loam cores, said there was one little point which needed careful working to overcome the tendency of the loam to rise on the barrel. The winding of straw round the barrel was a source of weakness which developed during the drying process and which was not seen but which made itself felt when they took the pipe or column out and found they had got uneven thicknesses. To overcome the difficulty he found from experiment that it was desirable to have what they termed a finger room between the bonds of hay or straw, so that they had one thickness of hay and one thickness of loam. These acted as pillars, making a continuous thickness of loam throughout the whole length of the barrel core. His experience in experimenting, he would not say with oil but with what they used years ago, namely, black treacle and sea sand, was that there was no question that they produced successful cores.

Favours Loam.

MR. J. B. JOHNSON said he was not entirely converted to the universal use of oil-sand cores, and he still thought there was room for a good loam core. He had had years of experience with columns and pipes, and he was of opinion that a loam core for this purpose was much to be preferred to an oil-sand core. During the past session he had visited many first-class foundries, and it had been an education to him and to other members of the Branch to see the uses to which oil sand was put to-day. There was no doubt that wonderful work was being done, but in the case of a small jobbing foundry there were great difficulties in the extensive use of oil sand. He understood that to make a real success of oil-sand cores special apparatus was necessary for mixing, etc., and that apparatus would not be available in a small foundry. He still maintained that for pipes and similar things the old-fashioned loam could not be improved upon.

MR. E. J. LEWIS inquired whether it was possible to dry oil-sand cores successfully in a core stove containing green-sand cores. As to the gauging of cores, he said that in every up-to-date foundry the gauge was always used in the case of cylinders and cranks. There was scope in the present-day foundry for a large extension of the use of oil-sand cores.

The Author's Reply.

Replying upon the discussion, MR. EDWARDS emphasised the ease with which oil-said cores could be removed from the castings. They could very nearly blow them out, he said, whereas with dry sand they had to use prods, and it was often a laborious business. In the case of oil-sand cores it was unnecessary in most cases to use prods. It was well known that to-day the foundry, perhaps more than any other business, was lacking in the highest type of craftsmen. In these circumstances he thought the rational course was to adopt methods which cut out much of the risks attendant upon the production of loam cores. He did not regard it as necessary to have any special form of drying apparatus. The ordinary core stove, used with common sense, would suffice to dry practically any kind of core. Gas stoves were ideal because the heat could be regulated.

MR. JOHNSON: I had in mind mixers rather than stoves.

MR. EDWARDS replied that many foundries used oil-sand cores without any special mixers, adding that it was in the jobbing foundry where the oil-sand core would be often of advantage. It was quite possible to dry oil-sand cores successfully in the company of dry-sand cores, though it was better, of course, to keep the oil-sand cores separate.

* This Paper appeared in our last issue.

Is the Foundry Industry "Bucking Up?"

This query is prompted by recent experiences of the writer, which appear to show that during the past twelve months the industry has made a definite move forward. The line of vision of any one individual is necessarily limited (in the practical sense), and any conclusions he arrives at must be based upon observation and deduction; that is to say, he observes the methods employed by the various foundries he comes into contact with, and forms conclusions as to what those methods portend.

During the past twelve months the writer has been in contact with upwards of a dozen different foundries situated in different parts of the country, and in almost every instance there are indications that the foundry management is determined to give better service. This determination is not of the hysterical variety, based upon panic on account of falling business, but is of the cool and calculated order, as though the management is working out a carefully thought-out plan.

It is not an uncommon thing for an individual to note one or two foundries rising out of the rut, for some are, of course, more progressive than others; but when there is a general tendency to rise to a higher level, it may be taken for granted that this is indicative of an improvement in the industry as a whole.

In the first place, price-cutting is not in evidence, and the remarkably slight variations in the prices quoted by half-a-dozen foundries for a certain type of light casting show that the estimates are based upon something definite—that "something definite" obviously being reliable costing data.

Having obtained the order, the next thing that strikes one is the obvious desire of the foundryman to satisfy his customer in the matter of delivery. In these days of programmes and schedules the problem of "outside supplies" is an acute one for the management of an engineering factory, and when castings are included in the category of "outside supplies" the position is rendered still more difficult.

Often the buyer is at fault in not placing his orders early enough, and without taking into consideration the fact that the foundry has other customers upon its books. He will endorse his order "Delivery required in seven days certain," when ordinary common-sense should tell him that such a delivery is impossible; but as the order is accepted by the founder without comment, it is assumed by the customer that the delivery given holds good. When at the expiration of the time the castings are not to hand the buyer wants to know why, as he feels he has been "let down." He has passed on the date to the production manager, who has used it as the basis for his machinery programme; when the date has expired and the castings are not to hand, this programme obviously cannot be adhered to, and then there is trouble between the production manager and the buyer. The latter blames the founder; acrimonious correspondence passes between them; the buyer places a subsequent order elsewhere, and the founder vows he will have no further dealings with such a buyer.

All this could be obviated by a little tact on the part of the foundryman, and it is in this connection that the second improvement is in evidence. Upon receipt of an order asking for an impossible delivery, the founder immediately informs his customer, in a courteous manner, that the delivery asked for cannot be met, and gives a definite promise. This enables the buyer to arrange for a revision of the machinery programme before any harm is done, and as the promise given by the founder is honoured, this little attention promotes cordial business relations.

It may be in certain circumstances that the promise given by the founder will not meet the requirements of his customer, and in such a case the buyer may suggest a somewhat earlier date. The founder then makes every effort to fall in with the views of his customer, but if, after the most thorough investigation, he finds it impossible to do so, he states the position quite frankly, and suggests that, if the date given is not satisfactory, the order in this instance should be placed elsewhere.

This is the common-sense way of doing business, for it demonstrates the desire of the founder to meet the wishes of his customer, and where necessary shows what cannot be done. The old axiom "Get the order at all costs" is superseded by "Get every order that can be executed to the customer's satisfaction," and whilst the former gets first orders (often at a loss) and no repeat orders, the latter gets orders all the time.

The third example shows the desire of the foundryman to give satisfaction in respect to quality, and although this does not mean that in every instance better castings are being provided, it does mean that every complaint of the customer is sympathetically received and is carefully investigated. Further, there is the tendency to discuss the matter frankly, and should the trouble be due to factors outside the foundryman's control, such as patterns, etc., the latter does not hesitate to say so.

In the past it has been considered bad policy to "hurt the customer's feelings" by adversely criticising his patterns, and as a result the founder has had to bear a heavy loss, as well as bear the reputation as a provider of indifferent castings, because he has lacked courage to tell the customer where he is at fault. The customer may be sensitive upon the matter of patterns, but the founder is doing himself (and his customer) an injustice by accepting responsibility for something outside his control. The average engineer has very little real knowledge of foundry work; what he *does* know is that the casting is a good (or bad) one for the purpose intended. He knows little more about patterns, but he claims to have a competent pattern maker upon whose judgment he implicitly relies. It has been proved time and again, however, that the most efficient working patterns are those produced where co-operation exists between the patternshop and foundry, and this co-operation does not exist in the engineering shop unless it has its own foundry.

It is the fact of the customer appreciating his lack of knowledge that makes him sensitive of criticism in respect to his patterns, but criticism can take the form of suggestion and need not give offence. It cannot be done by correspondence, however, but by personal discussion, the foundry manager visiting his customer's works and discussing the matter with the engineer and the pattern-maker. In several instances recently an abnormal amount of scrap developed in connection with the castings received from a certain foundry, and the foundry manager visited the works. He discussed the matter quite frankly, and made suggestions in regard to the patterns, which were duly carried out. The result was that scrap was practically eliminated, and quite a number of other patterns were altered in accordance with his suggestions, with similarly good results, although in some cases the castings were obtained from other foundries.

When the scrap is obviously the fault of the foundry, the same desire to get over the trouble is in evidence. Instead of the customer being dubbed as "hypercritical," a genuine endeavour is made to rise to his standard. Not long ago a foundry manager spent several hours in an engineering factory studying the various machining operations and the positions of certain castings in the completed unit. He confessed it was quite an education, and the improvement in the castings subsequently delivered showed that he had indeed profited by his education.

The writer contends that these instances show that "Better service" is the aim and object of the foundry industry, and it is his belief that the movement is widespread. And why should it not be? We are living in an age of enlightenment and progress, forced upon us by the unparalleled conditions of the last fifteen years, and we must either rise higher or become submerged. The foundry has been regarded by many people as the least progressive branch of the engineering industry, but however true this may have been in the past, to-day the foundry industry is "bucking up." This is, at least, the opinion of "a London Buyer."

Electric Pig-Iron Manufacture in Sweden.*

By Professor J. A. Leffler (Stockholm, Royal Technical University).

The first experimental electric shaft furnace for making pig-iron in Sweden was erected by the Jernkontor at Trollhättan, and started in November, 1910. As the working of this proved successful, others were subsequently erected at Hagfors, Domnarfvet, Söderfors, and Porjus, and by 1921 fourteen of them were completed, their power input ranging from 2,200 to 4,500 kw. Short descriptions of some of these follow:—

The Uddeholm Plant at Hagfors.

This plant consists of five shaft furnaces. The electric energy, supplied from the power station of Uddeholms A.B., is a 3-phase alternating current of 25 cycles and 12,000 volts primary pressure. For each furnace three water-cooled oil-insulated transformers are installed, one for each phase. In the transformers the pressure is reduced per phase to 50-100 volts, and can be regulated in eight steps by means of special regulators. The pressure per electrode varies usually between 35 and 50 volts, and the current strength between 15,000 and 18,000 amps. Each furnace has six round carbon electrodes, and the electric current is led to them through bare copper bars. Diametrically opposite electrodes are coupled to the same phase.

The furnace shafts are supported on iron columns on the ground level. The furnaces are enclosed in casings of iron plates, and provided with single-closing, charging hoppers of the "Tholander" type. The shaft is lined with ordinary firebricks, the hearth and its roof with best fireproof bricks. From all the furnaces a common 28-in. dia. pipe conducts the gas to the open-hearth department, where it is used for heating the furnaces. The gas is cleaned in the gas conduits by water sprays. The circulation of the gas is effected by means of water-cooled high-pressure blowers. The water consumption for the washing of the gas is 35 gallons per min., and for cooling, 90 gallons per min. are required for each furnace.

The charcoal, which is conveyed on an aerial ropeway to the charging floor of the furnace, is carried in cylindrical charging vessels with bottom doors. The ore and limestone are unloaded direct from the railway wagon into a crusher. Under the crusher an ore wagon is placed, which is conveyed on an inclined track to the charging floor where it empties its contents into a tipping wagon which runs above the ore bins. The electric hauling arrangements for the ore wagon and the tipping wagon work automatically.

Pig-iron and slag are tapped at the same time, the iron into shallow cast-iron moulds, or into ladles for the Bessemer department, and the slag into funnel-shaped cast-iron moulds. In the casting department are two electric overhead cranes of 3 and 10 tons respectively, and a railway track passes through the building.

The total annual capacity of the entire plant is about 45,000 tons.

Plant of Stora Kopparbergs Bergslags A.B. Domnarfvet.

This plant comprised four electric shaft furnaces, while a fifth furnace was under construction at the time of writing. The four already in operation are numbered Nos. 2, 4, 5 and 6 respectively. The electric energy, obtained partly from the power station of the Company at Bullerforsen and partly from Mockfjärd, is a 3-phase alternating current of 6,800 volts, 60 cycles. For Furnace No. 2 the transformers are placed immediately and symmetrically around the furnace; for the others they are in a row alongside the furnaces. Those for Furnaces Nos. 2 and 5 are air-cooled single-phase transformers, there being 3 for each furnace. The transformers for Furnaces Nos. 4 and 6 are water-cooled, oil-insulated, double single-phase transformers of a capacity of 5,000 k.v.a., and there are 2 for each furnace. The low pressure is 60-120 volts, which can be regulated in 9 steps.

Furnaces 2 and 5 have each six carbon electrodes and Furnaces 4 and 6 eight each. Furnace No. 2 has 24-in., the other furnaces 28-in. electrodes.

The pressure on each phase, measured at the furnaces, is 70-90 volts. For the 24-in. electrodes a current strength of 14,000-15,000 amps. is used; for the 28-in. electrodes 18,000-20,000 amps.

The maximum annual output of the furnaces is as follows: Furnace No. 2, about 11,000 tons of pig iron; Furnace No. 4, 14,000 tons; Furnace No. 5, 12,500 tons; Furnace No. 6, 14,000 tons; total, 51,500 tons of pig-iron per year.

The furnaces are placed about 6 ft. 6 in. above the ground level, which makes it possible to tap the pig-iron and slag into wagons standing on the floor. The furnace shaft is supported on girders resting on the walls of the building.

The charcoal is transported by means of an aerial ropeway directly from the coking plant of the works, the ore (uncalcined) and lime in a wagon holding a ready-mixed charge, which is emptied into a pocket above the rotating hopper, in which the charge is put down by means of a rotating drum.

Two of the shaft furnaces are equipped with "Tholander" charging hoppers, and two have Parry's funnels. The shaft furnaces are intended for production of pig-iron for direct blowing in the basic-steel plant, and are almost entirely used for that purpose. The pig-iron contains about 0.5 per cent. Si, 0.6 per cent. Mn, 2.0 per cent. P., and 0.010 per cent. S.

Stora Kopparbergs Bergslags Plant at Söderfors.

This plant comprises one furnace built in 1915. Since then the shape of the furnace has been changed several times in order to facilitate the steady sinking of the charge. The changes have been in the direction of making the shaft more cylindrical and wider at the bottom. The electric energy, 3-phase alternating current at 50 cycles, is supplied from the power station of the Swedish Government at Älvkarleö and has a high pressure of 18,000 volts at Söderfors. In the three water-cooled, oil-insulated transformers the pressure is reduced to 50-100 volts, and can be regulated in 8 steps. The six electrodes are of carbon and are 24 in. diameter. The shaft is supported on girders resting on the walls of the building.

The gas leaves the furnace through a single outlet of 32-in. dia. The slightly-inclined flue is cleaned by water-sprays. For further cleaning the gas and for its circulation, two water-cooled high-pressure fans work alternately, each one in combination with a third blower of the "Jaeger" type, and constructed for a maximum pressure of 30-in. of water and 2,830 cub. ft. of gas per min. Each blower is driven by a 20-h.p. motor.

The charcoal is conveyed by means of an aerial ropeway; ore and lime in wagons.

The power input of the furnace is 3,000-4,000 kw., and it produces up to 12,000 tons of pig-iron per year for use in the open-hearth.

Plant at Trollhättan.

This plant is identical with that at the Jernkontors experimental works at Trollhättan, and comprises 2 furnaces, the older one (No. 1) of 2,000 kw., and one (No. 2) of 3,000 kw.; the latter started operation in 1917. The capacities are about 7,000 and 9,000 tons of pig-iron per year respectively. In the course of years the design of Furnace No. 1 has been changed for the purpose of obtaining greater width in the throat.

The electric energy is supplied as a 3-phase alternating current of 10,000 volts at 25 cycles. The smaller furnace has 2 and the bigger 3 oil-insulated, water-cooled transformers in which the pressure is reduced to 50-90 and 50-100 volts respectively, which in both cases can be regulated in 8 steps. The capacity of the transformers for Furnace No. 1 is 1,100 k.v.a., and for Furnace No. 2 1,250 k.v.a. The smaller furnace has 4 electrodes and works with a 2-phase current

* Extract from a lecture before the Swedish Engineers' Society.

(Scott's connection); the larger furnace has 6 electrodes and operates with 3-phase current. Round carbon electrodes of 24 in. diameter are used for both furnaces. Diametrically opposite electrodes are coupled on the same phase. The furnace shafts are supported on girders resting on the walls of the furnace building. The charging hoppers are of the "Tholander" type. The furnaces produce mainly pig-iron for open-hearth furnaces.

A.B. Porjus Smältverk Plant at Porjus.

Two furnaces are in operation here, and a third was planned. All are of the same size—3,000-kw., with a capacity of 9,000 tons of pig-iron per furnace when worked without interruption. The energy supply is a 3-phase alternating current of 10,000 volts at 25 cycles. Each furnace has 3 transformers of 1,250 k.v.a. each. By means of pressure regulators the low pressure can be regulated between 50 and 100 volts in 8 steps. The furnaces have 6 round carbon electrodes 24 in. diameter. They operate with charcoal and A-ore from Kiruna and Gellivare, and produce chiefly pig for open-hearth furnaces.

Chemical and Physical Properties of the Ores Used.

The economical carrying out of electric pig-iron production is largely dependent on the percentage of iron in the ore and on the other constituents, as well as on their physical nature. An ore with a high percentage of iron and of such composition that it forms a suitable, fusible slag, is the most suitable for the process, provided that it is in lumps without dust. Regarding this process, it should be remembered that the volumetric proportion between reducing agent and ore is much less than in a blast furnace, and that the physical condition of the ore therefore is of more consequence for helping the passage of the gases up the shaft. In certain cases it has been possible to use up to 20-30 per cent. of dusty ore, but it depends very much on the condition of the reducing agent, whether, and how much, fine ore can be used.

Chemical and Physical Properties of Reducing Agent.

As the reducing agent in electric shaft furnaces of the "Elektrometall" type charcoal is used exclusively in Sweden. On account of its purity from P and S and of its comparatively low percentage of ash, as well as its low specific weight, this reducing agent is especially suitable. Further advantages are its great porosity and the fact that it does not sinter at the temperature at which the constituents of the ash melt; nor is any addition of lime necessary in order to fuse the ash. With such a reducing agent an effective gas circulation in the shaft can be easily maintained, and reduction with CO thus can be attained in the highest degree. The charcoal is made almost entirely from pine, has a weight per volume in dry condition of 110-140 kgs. per cubic metre (186-237 lbs. per cub. yard), and contains usually 7-15 per cent. moisture. Furnace charcoal from round wood has proved to be very suitable for electric shaft furnaces. Less suitable is small flat charcoal, such as is obtained from the saw mills, as it often causes stoppages.

Electrodes.

In Sweden, round carbon electrodes are used almost exclusively either of Swedish make or imported from Germany or the United States. The usual diameter is 24 in., and the length 6 ft. to 6 ft. 8 in. Electrodes of 28 in. dia. are also used in large furnaces in lengths up to 10 ft.

Pig-Iron and its Composition.

In the modern Swedish electric shaft furnaces pig-iron of several kinds is produced, such as acid and basic Bessemer, and iron for the open-hearth and "Lancashire" processes. Some analyses are given in Table I:—

TABLE I.—*Analyses of Swedish Electric Pig-irons.*

	C.	Si.	Mn.	S.	P.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Acid Bessemer	—	1—1.5	3—3.5	0.008	0.016
Basic ,,	—	abt.0.50	0.60	0.010	2.000
Open-hearth	3—3.5	0.65	0.31	0.018	0.015
,, ,,	3.65	0.33	0.39	0.010	0.016
Lancashire	—	0.28	0.31	0.018	0.016
,, ,,	2.88	0.41	0.22	0.018	0.042

The slag from electric shaft furnaces is on the whole similar to the slag obtained in blast furnaces from the same ore.

Furnace Gas and its Use.

In the electric shaft furnace about 600 cub. metres (21,100 cub. ft.) of gas are obtained per metric ton of pig-iron, or only about one-seventh of the quantity obtained in a blast furnace. Of course, no blast is used, and consequently the gas consists entirely of elements contained in the ore, lime, and reducing agent. Its composition is therefore entirely different from blast-furnace gas. It contains volumetrically on an average 15-30 per cent. of CO_2; 55-70 per cent. of CO; 8-12 per cent. H; 0.5-2 per cent. CH_4; and 0.5-2 per cent. N. The calorific value of the gas in dry condition is 1,900-2,600 heat units per cubic metre.

Economics of the Electric Shaft Furnace.

Some of the factors which influence the cost of the production of pig-iron by this process are discussed in the following paragraphs.

Consumption of Reducing Agents.—As against the usual blast-furnace process, the percentage of iron in the charge has no influence on the consumption of the reducing agent. What does influence it, however, is the possibility of an efficient reduction with CO, thus obtaining a gas with the highest possible percentage of CO_2. This depends mainly on the gas circulation and the reductivity of the charge. The lowest attained charcoal consumption has been 305.3 kg. (671 lbs.) per ton of pig-iron produced. When estimating it is safe to calculate on a consumption of 350-400 kg. (770-880 lbs.)

Consumption of Electric Energy.—The consumption of electric energy is chiefly dependent on the percentage of iron in the charge, as well as on the design of the electric installation, and the design and size of the furnace. It depends also to a great extent upon the kind of pig-iron to be produced. If the iron has a low percentage of Mn and Si the furnace will work "cold" and the losses by radiation and conduction will be less than if a pig-iron richer in Mn and Si is produced, because this requires "hot" working. Due to these different circumstances, the energy consumption varies widely from about 2,000 up to about 3,000 kw.-hours per metric ton of pig-iron.

Observations carried out in Furnace No. 1 at Trollhättan revealed the fact that about 75 per cent. of the electric energy brought to the furnace, measured on the high-tension side of the transformers, had been consumed in the process. Perhaps in the most modern furnaces the energy is even more completely utilised. In this connection the load capacity must be taken into consideration. If, for example, a firm has made an agreement regarding delivery of a certain number of units per year at a certain price, the aim of the shaft furnace plant will be to utilise this energy completely in order to reduce the power costs per ton of pig-iron as much as possible. This can best be done if the plant comprises several units.

Electrode Consumption.—The electrode consumption depends almost entirely on the quality of the electrodes. During the war it was impossible to obtain electrodes of good quality, and the consumption was often very great, 15-20 kg. (33-44 lbs.) per metric ton of pig-iron. If the quality is good the consumption ought not to exceed 5 kg. (11 lbs.) per metric ton of pig-iron, provided that the furnace is run regularly. Under exceptionally favourable conditions the consumption has been as low as 3 kg. (6.6 lbs.).

Upkeep of the Furnace.—The cost of the upkeep of the furnace is largely dependent on the percentage of Mn and Si in the pig-iron. If these percentages are high, that is, if the furnace is working "hot," the lining and the roof of the hearth will be destroyed quickly, but if they are low the destruction will proceed slowly, and the maintenance costs will be comparatively small.

The hands required for an electric shaft furnace plant consisting of three furnaces producing about 30,000 tons a year will be 75 men, including foremen, working 8-hour shifts, and a staff of six.

Trade Talk.

Cox & Danks, Limited, have been successful in raising the eleventh German destroyer S.65 at Scapa Flow.

The Harris Furnace Company, Limited, Windsor Street, Attercliffe Road, Sheffield, have removed to 427, Queen's Road, Sheffield.

A licence under the Non-Ferrous Metal Industry Act, 1918, has been granted by the Board of Trade to Tata, Limited, Capel House, New Broad Street, London, E.C.2.

The United Steel Companies, Limited, Workington, have secured the order for 5,000 tons of rails and for steel sleepers for the 50-mile extension of the Barsi Light Railway Company's line to Miraj (Bombay).

Vickers, Limited, have received an official order from the Australian Government for two submarines. They have also been instructed to proceed with the construction of the gun mountings for one of the two cruisers building in this country.

Howden-Ljungstrom Preheaters (Land), Limited, are supplying one preheater to John Galloway & Company, Limited, Balerno, near Edinburgh. The total heating surface is to be 26,700 square feet, and air will be supplied to the furnace at about 570 deg. F.

The Blue Star Line, Limited, have placed orders for two vessels with Lithgows, Limited, of Port Glasgow, and for two others with Palmers Shipbuilding and Iron Company, Limited, of Newcastle-on-Tyne. The remainder of the orders are now being negotiated for.

The receivers for the mortgagee and debenture holder of the Redheugh Iron & Steel Company, Limited, Teams, Gateshead-on-Tyne, announce that the liquidation proceedings before the High Court of Justice, on 12th inst., will not in any way interfere with the carrying on of the business.

K. Malmberg, of 110, Cannon Street, London, E.C.4, has established a branch at 2, Lilla Nygatan, Gothenburg, Sweden, where the business of iron, steel and metal merchants and agents will be carried on. Mr. Malmberg has recently taken over the agency of Spenskt Export Tackjarn for the sale of Swedish charcoal pig-iron in Great Britain.

The annual dinner of the Junior Institution of Engineers was held at the Monico Restaurant on Wednesday, May 13, Dr. Alexander Russell, the president, being in the chair. The guests of the evening included Air Vice-Marshal Sir W. Sefton Brancker (Director of Civil Aviation), Sir Charles L. Morgan (past-president of the Institution of Civil Engineers), and Mr. J. S. Highfield (president-elect).

Sir W. G. Armstrong, Whitworth & Company, Limited, have recently booked new orders for oil tankers. One is for the Baltic Trading Company, London, with which the Aragaz Oil Company is associated, and another is for Norwegian owners. The Company have also secured a contract from the Mersey Docks and Harbour Board for the supply and erection of three pairs of steel gates for the river entrance of the Alfred Dock at Birkenhead, which has a width of 80 ft.

Before the Wales and Monmouth Branch of the Institute of British Foundrymen, Mr. C. A. Howe gave a Paper on "Cast Iron." The lecturer outlined the nature, distribution and formation of iron ore, described its reduction in the blast furnace, pointing out the conditions which produced grey and white irons. Finally, he dealt with the influence of the elements on the properties of cast iron. The Paper was of a general revisionary character, and allowed of a general discussion, in which the relative efficiencies of the reverbatory and cupola furnaces was paramount.

Personal.

Mr. S. L. Pearce, general manager and chief engineer of the Manchester Corporation electricity undertaking, has been appointed an Electricity Commissioner.

Mr. Robert J. Anderson, the well-known American consultant for light alloys, who was at one time associated with the Bureau of Mines, has opened an office at 221, Amber Street, E.E., Pittsburgh, Pa.

Mr. A. Wimble, at present works manager of the Wallsend works, has been appointed general manager of the North Eastern Marine Engineering Company, Limited, as successor to Colonel H. G. Luhrs, who was recently elected managing director of Henry Watson & Sons, Limited, engineers and brassfounders, Walker Gate. Mr. Wimble has been succeeded by Mr. Henry Hunter, son of the managing director, as works manager, with Mr. Wood and Mr. Eckford as assistant managers.

Contracts Open.

Montevideo, July 20.—Two electric cranes, for the Administracion Nacional del Puerto de Montevideo. The Department of Overseas Trade. (Ref. No. A.X. 1973.)

Cairo, June 13.—The Physical Department, Ministry of Public Works, require 40,450 cast-iron weights of various dimensions. The Department (Room 43), 35, Old Queen Street, London, S.W.1.

Cape Town, July 6.—The South African Railways and Harbours require 322,810 lbs. round copper bars for firebox stays, etc., varying in diameter from ¼ in. to 2½ in. The Department of Overseas Trade, Room 48.

Portland, June 15.—Execution of under-water repairs to the Chesil 12-in. diameter cast-iron sea outfall, including the provision of all diving tackle, appliances and labour, for the U.D.C. Mr. R. Davison, engineer and surveyor, Council Offices, Portland.

Company News.

J. & E. Hall, Limited.—Interim dividend, 2½ per cent., less tax, on ordinary shares.

Hall and Cooper (Walsall), Limited.—Capital £1,000 in £1 shares. Engineers, ironfounders, etc.

Iron and Steel Company of New Zealand, Limited, 139-141, Cannon Street, London, E.C.—Capital £30,000 in £1 shares.

Ferodo, Limited.—Dividend, 12½ per cent., actual, tax free, making 15 per cent. for nine months; reserve, £28,750; carried forward, £13,322.

Park Gate Iron and Steel Company, Limited.—Profit, £50,498, applied to reduce balance of loss carried forward in profit and loss account.

Carmichael & Partners, Limited, Fitzalan House, Arundel Street, Strand, London, W.C.2.—Capital £500 in £1 shares. Engineers. Directors: E. Smith and W. G. Bayman.

British Thomson-Houston Company, Limited.—Profits, £514,980; brought forward, £210,863; total, £725,843; interest on debentures and loans, £122,595; depreciation, etc., £216,953; dividends on preference shares, less tax, £81,375; dividend on ordinary shares, 6 per cent. per annum, less tax, £93,000; carry forward, £211,920.

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Blacking, Coal Dust, Plumbago, Charcoal, Core Gum, Terra Flake, Gannister, Core Oils, Sea Sand, Moulding Sand, Iron Cement, Brushes, Bellows, Buckets, Chaplets, Core Ropes, Core Tapers, Ladles, Crucibles, Cupolas, Riddles, Sprigs, Spades, Carborundum Bricks and Wheels, Ferro-Aluminium, Blacking Bags, Foundry Plant, Etc., Etc., Etc.

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Very unstable conditions may again be noted as the prevailing feature in the Cleveland iron market, wherein, of late, business continues lifeless and the prospects of early expansion are still remote. At present the position is exceptionally favourable for buyers, who can at all times command price concessions for any reasonable-sized parcels, while the weakening of Continental producers is an encouragement to competition from that source of supply. On the export side, also, business remains poor, shipments from Tees-side ports so far this month being hardly half the tonnage recorded for the corresponding period in April. At this week's market values showed further weakness, No. 3 G.M.B. declining to 75s. per ton, both f.o.b. and f.o.t. No. 1 was quoted at 80s., No. 4 foundry at 74s., and No. 4 forge at 73s. per ton.

LANCASHIRE.—With continued stagnation in the local consuming industries, business in foundry pig is confined to retail proportions, sellers holding to 82s. 6d. delivered in Manchester as their bottom price, while some still stand out for 83s. 6d. There is, however, no great opportunity of making large sales for extended delivery at either price, for foundrymen have suffered too much recently from buying in advance of requirements. The price of Northamptonshire iron remains at 70s. on trucks at the furnaces, and does not come into competition with Derbyshire iron here, although it is much cheaper for some of the Midland consumers.

THE MIDLANDS.—In this area pig-iron values have developed further weakness, though consumers express doubts whether lowest levels have yet been reached. Local ironfounders are still holding off purchasing for forward supplies, contenting themselves with quantities to last week by week, and it would be difficult to say what figure would be taken by the Derbyshire and Northants furnaces for No. 3 foundry if a good order was placed before them. There is no Continental foundry iron coming into this area, prices not being competitive. Ruling prices for pig-iron are as follow:—Derbyshire No. 3 foundry, 74s. to 75s.; Staffordshire No. 3 foundry, 75s.; Northants No. 3 foundry, 69s. to 70s.

SCOTLAND.—No improvement can be noted in the state of the Scottish markets for foundry pig, except that Continental iron is more in evidence, and is being offered at considerably lower prices than were being asked in recent weeks. For No. 3 Scotch foundry the quotation is nominally 85s. 6d. at the furnaces, but only a limited business is passing.

MACHINERY.—*Continued from page 20.*

MACHINERY, PLANT, &c.

NEW HYDRAULIC BRICK PRESS, with rotary table, for making two magnesite bricks simultaneously, by Brinck & Hubner, Ltd.

Nearly New HYDRAULIC INTENSIFIER, with rams 17 in. x 9½ in. diam., 5-ft. stroke; hydraulic pressure, 1,500 lbs.; intensified pressure, 2 tons.

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NEARLY NEW STEEL LANCASHIRE BOILER, 30 ft. x 9 ft.; reinsurable at 100 lbs. working steam pressure; complete with steam and furnace fittings, etc.

FOUR LANCASHIRE BOILERS, 30 ft. x 8 ft.; reinsure 150 lbs. pressure.

Two very good dish-ended LANCASHIRE BOILERS, by Thompson, 30 ft. x 8 ft.; reinsure for 140 lbs. per sq. inch working pressure; ready for despatch.

TWO LANCASHIRE BOILERS, 30 ft. x 7 ft. 6 in.; now insured at 150 lbs. pressure.

CATALOGUE OF STOCK MACHINERY, 6,000 Lots. Free on Application. Inspection Invited.

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Ganister or Silica Bricks and Blocks (any shape or size). Sands, Cements, Ganister.—*Let us have your enquiries.*
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Normanby Brickworks, Normanby, Eston, Yorks.

Scrap.

Reports from the various markets for scrap material indicate little change in the general situation of the trade, which, at the moment, has reached a stage of depression almost unparalleled within recent years. In Lancashire, for example, cast scrap is certainly weaker, and although up to recently there was no great quantity pressing on the market, it seems to be getting plentiful, and weaker dealers are cutting the prices. Common cast scrap is probably not worth more than 75s. per ton to-day, but even at that low figure there is no anxiety on the part of the ironfounder to buy. Of course, the foundry industry is not active in the district, and only a small quantity of scrap is needed for mixing purposes. Even the finest textile machinery scrap is quite difficult to sell just now, although it may be had at 80s. Scottish ironfounders are still endeavouring to beat down prices of machinery and ordinary cast-iron scrap on account of the low price of pig-iron. First-class machinery cast iron in pieces not exceeding 1 cwt. is 85s. to 87s. 6d. per ton, and for ordinary to the same specification about 5s. per ton less. Steelworks cast-iron scrap in furnace sizes has been sold at 77s. 6d. to 78s. 6d. per ton. Cast-iron railway chairs are again easy, and can be obtained at 82s. 6d. and 83s. 6d. per ton.

Metals.

Copper.—With only trifling fluctuations in values from day to day, the tone of standard copper may be described as fairly steady, but business generally remains quiet in the absence of speculative activity. In this country needs in the electrical industry seem to have been already fairly well provided for the time being, but German consumers are inadequately covered, and will probably have to re-enter the market soon. Copper stocks in Metal Exchange warehouses of the United Kingdom at the end of April totalled at 44,968 tons, compared with 44,276 tons at the close of March. Current quotations:—*Cash*: Thursday, £60 2s. 6d.; Friday, £60; Monday, £60 2s. 6d.; Tuesday, £60; Wednesday, £60.

Three Months: Thursday, £61 2s. 6d.; Friday, £61; Monday, £61; Tuesday, £61; Wednesday, £61.

Tin.—Values of standard metal made a steady advance over the past week, and closed some £4 to the good, with a fair demand. The American deliveries for the current month will probably disclose some falling off to, roughly, 5,000 tons, which may be offset by better outgoings in other directions; but, on the other hand, Straits shipments are expected to be larger, being estimated at about 6,500 tons. Therefore, the visible supply is about to experience a moderate increase. Current quotations:—*Cash*: Thursday, £248 10s.; Friday, £249 15s.; Monday, £251 5s.; Tuesday, £252 10s.; Wednesday, £255 2s. 6d.

Three Months: Thursday, £250 5s.; Friday, £251; Monday, £251 10s.; Tuesday, £252 10s.; Wednesday, £255 5s.

Spelter.—Movements in this metal during the past week have disclosed a slightly upward tendency, while there has also been a better demand for forward metal. The publication of the American statistics indicated a more favourable position than had been expected, the increase in stocks during April being only 1,141 tons. Belgian and German production is steadily on the increase, and American production is evidently well controlled at the source by the ore producers. Current quotations:—*Ordinary*: Thursday, £34 1s. 3d.; Friday, £34 5s.; Monday, £34 11s. 3d.; Tuesday, £35; Wednesday, £35 2s. 6d.

Lead.—The market for foreign pig has again developed an upward tendency in values, which, although confined to fractional advances, confirms the more hopeful view now taken of the position of the metal. Consumption in the States has improved considerably, and the A. S. & R. Company has raised its price to 7.90 c. per lb. Current quotations:—*Soft foreign (prompt)*: Thursday, £32; Friday, £32 2s. 6d.; Monday, £32 11s. 3d.; Tuesday, £32 15s.; Wednesday, £32 12s. 6d.

Callender's Cable and Construction Company, Limited.—Balance to credit of profit and loss account, £321,708; interest on debenture stock, £13,500; dividend on 6½ per cent. preference shares for year, £26,000; dividend on 7½ per cent. preference shares for year, £30,000; appropriation for depreciation of buildings, plant and machinery, £30,000; appropriation for depreciation of office furniture, £500; balance from 1923, £315,986; dividend on ordinary shares, 15 per cent. per annum, being 3s. per share, less tax; carried forward, £462,694.